EPIC
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EPIC SYMPOSIUM

Wildfire Prevention Technologies

Moderator: **David Erne**

Presenters: **Dr. Brian Chen, Brian D'Agostino, Dr. Larry Dale**

Wildfire Prevention Technologies

Breakout Session

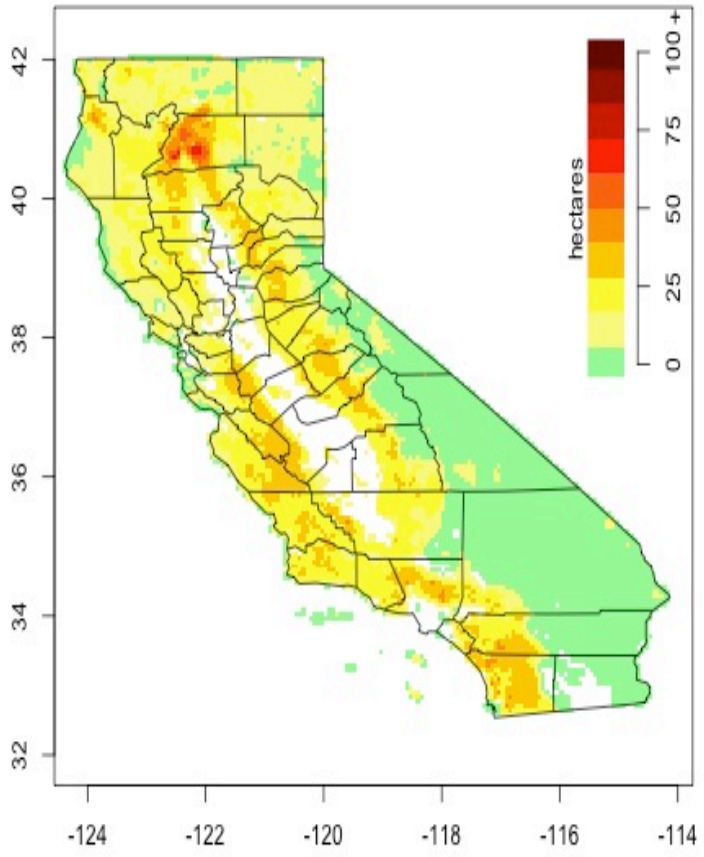
February 19, 2019

David Erne, Energy Technology Systems Integration

Wildfire Potential Increases with Warming Climate

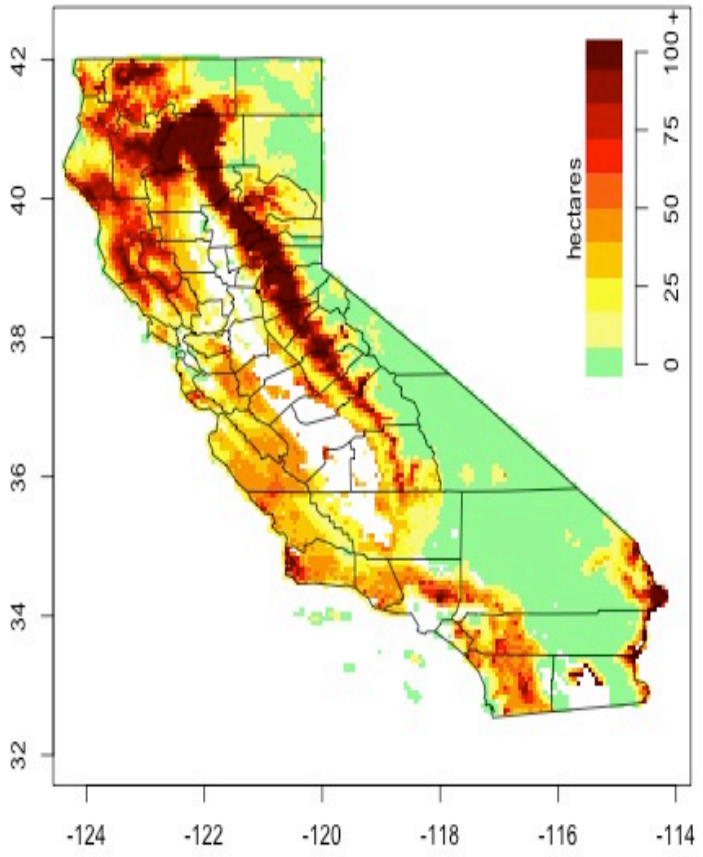
Historical Area Burned per Year

30-yr mean area burned: 1961-1990 CanESM2 85 bau



Projected

30-yr mean area burned: 2070-2099 CanESM2 85 bau



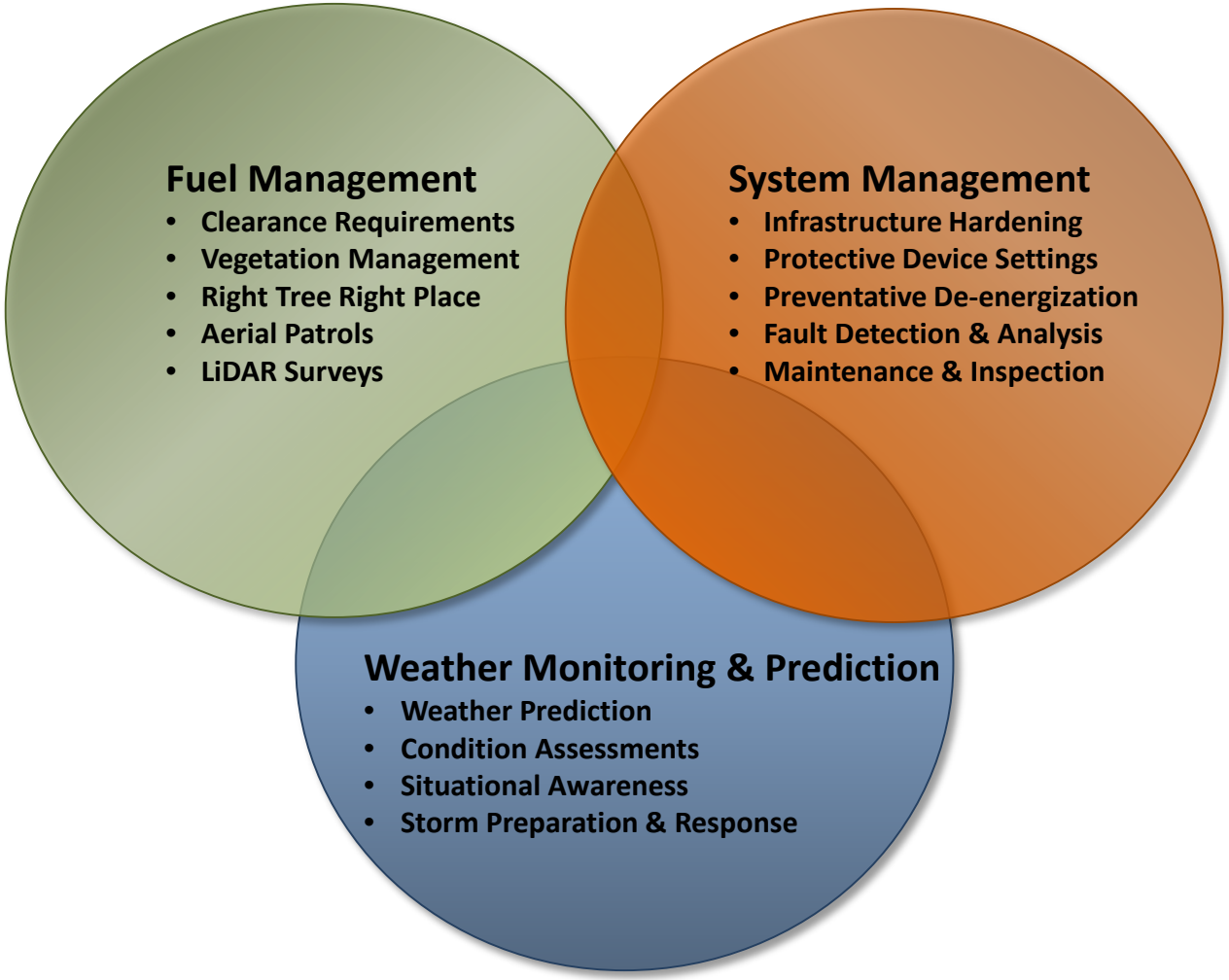
Source: Westerling, Anthony Leroy. (University of California, Merced). 2018. *Wildfire Simulations for California's Fourth Climate Change Assessment: Projecting Changes in Extreme Wildfire Events with a Warming Climate*. California's Fourth Climate Change Assessment, California Energy Commission. Publication Number: CCCA4-CEC-2018-014.

Active GFO-18-301

Wildfire: Assessing and Preparing for Risks under Climate Change

- Needs:
  - Phase I - Improve the assessment of risks to the electric infrastructure from wildfires
    - Near-term risk forecasting (7 days)
    - Long-term risk prediction for infrastructure planning
  - Phase II - Conduct analyses for California's Fifth Climate Change Assessment
- Funding: 1 award up to $5 million
- Released: December 27, 2018
- Proposals Due: March 13, 2019 by 5:00pm

Multiple Strategies for Wildfire Prevention



Ignition Prevention Research Coordination Working Group

- ***Held Public Workshops July 25 & October 16, 2018***
  - ***Identifying research priorities***
  - ***Coordinating research program efforts***
  - ***Sharing information***

Energy Commission Next Steps

Refine Research Areas

- Conducting market research

Oct 2018 – Feb 2019

Hold Public Workshop

- Convene working group to coordinate efforts
- To be held in SoCal

Mar 2019

Develop & Publish GFO

- Develop scope
- Publish GFO

Mar - July, 2019

Panel

Dr. Larry Dale

Staff Scientist
Lawrence Berkeley National Laboratory

Brian D'Agostino

Director of Fire Science and Climate Adaptation
San Diego Gas & Electric

Dr. Brian Chen

Principal Manager of Grid Resiliency and Public Safety
Southern California Edison

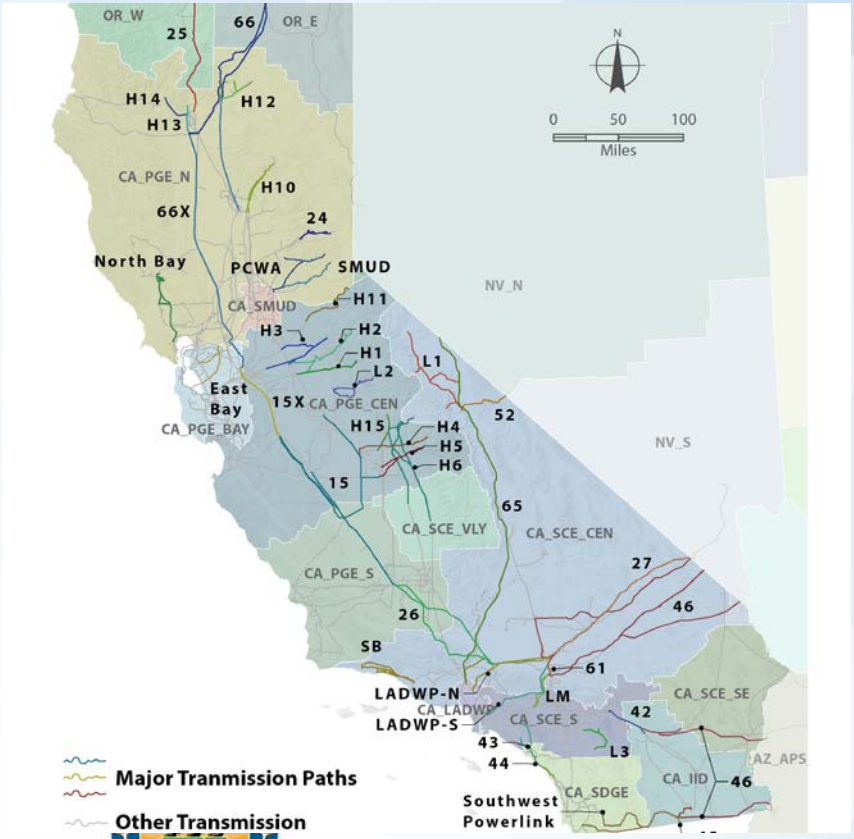
ASSESSING THE IMPACT OF WILDFIRES ON THE CALIFORNIA ELECTRICITY GRID

EPIC FUNDED PROJECT

Larry Dale, Michael Carnall, Max Wei
Lawrence Berkeley National Laboratory
Gary Fitts, Greenware Technologies
Sarah Lewis MacDonald, Envision Geo

We focused on selected parts of the transmission and distribution grid

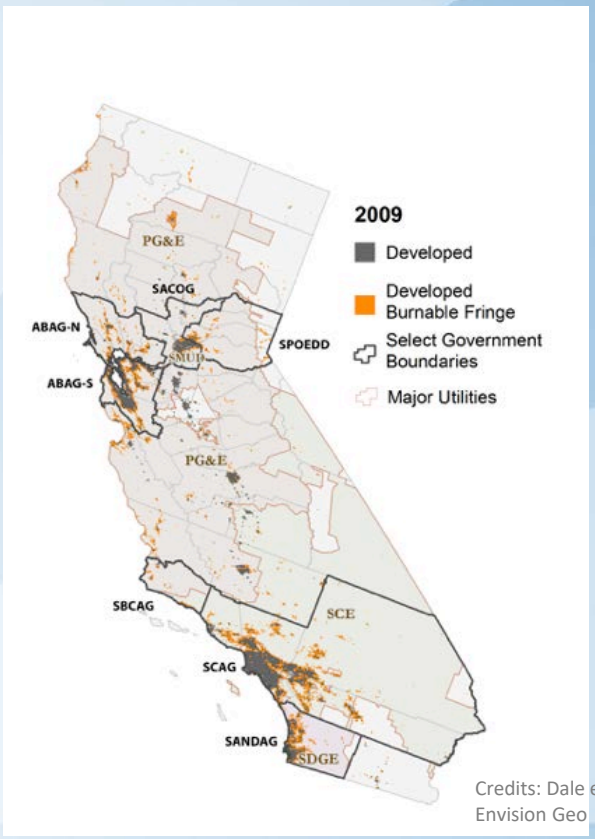
Transmission “Paths”



Credits: Dale et al. 2018.; CEC; WECC Envision Geo

Evaluated 351 historical wildfires approaching these paths.

Distribution “Fringe” Areas

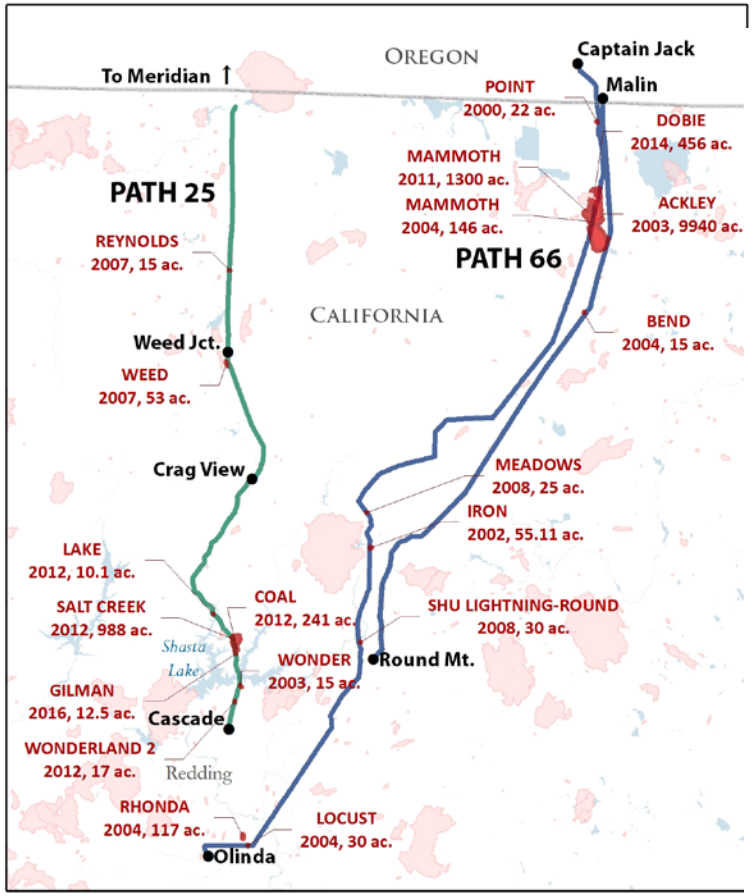


Credits: Dale et al. 2018.; USGS Envision Geo

Evaluated 360 historical wildfires approaching fringe areas.

We identified grid exposure to wildfires

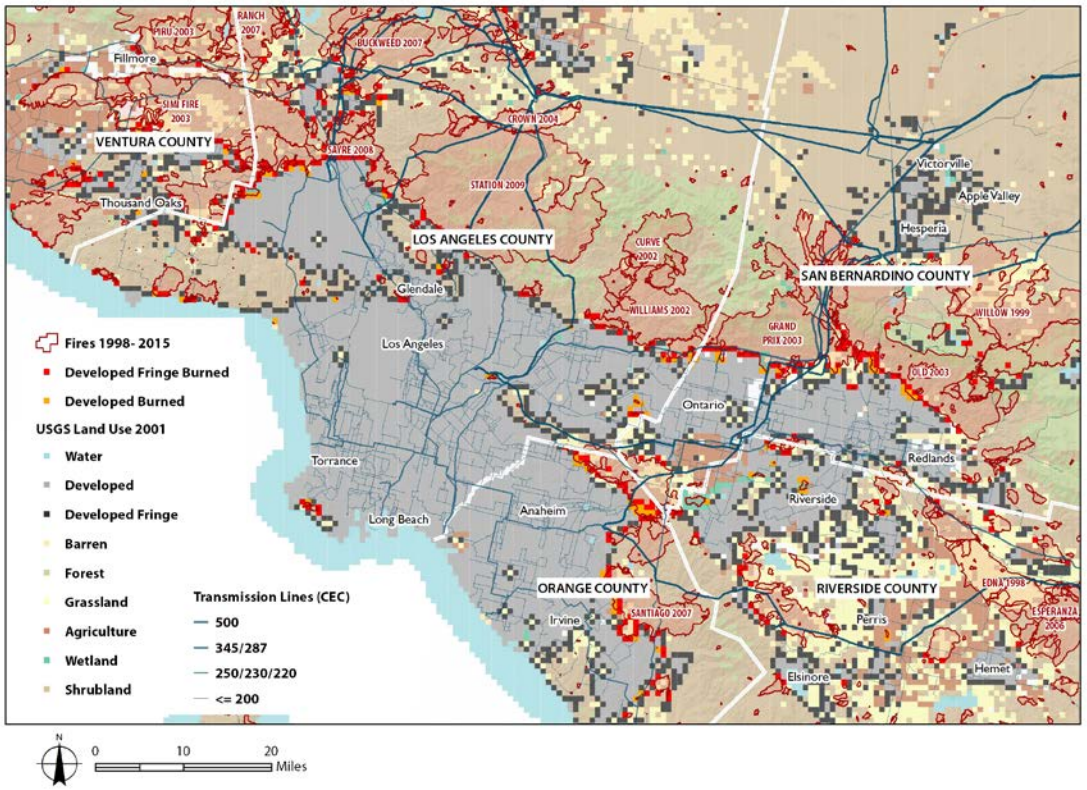
Transmission Paths 25 & 66
Nearby Fires 2000-2016



Major Transmission Paths
- Path 25
- Path 66
- Major Substations

Historic Fires (2000-2016)
- Fires >10ac. within 0.25 mi. of major path
- All other fires 2000-2016

Los Angeles basin fringe
Nearby fires 2000-2016



We rated the impact severity of the fires

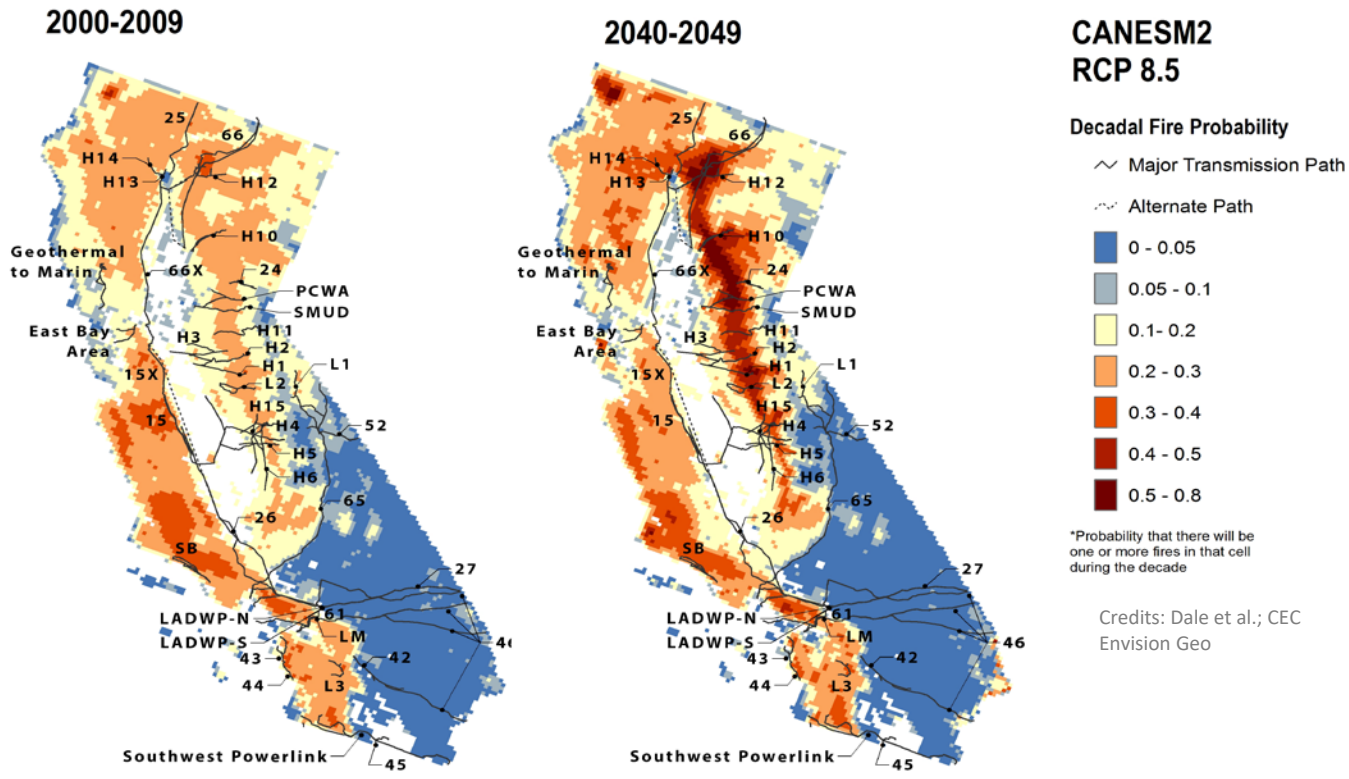
Transmission: CAISO rating system (351 fires)

Distribution: LBNL rating system (361 fires)

		Transmission Impact Severity Level				
		1	**2**	**3**	**4**	**5**
		Low	**Small**	**Medium**	**Large**	**Very Large**
	(# fires)	No CAISO action	Local impact	Change dispatch	Outage, re-dispatch	System wide threat
WECC Paths	125	69%	2%	15%	13%	2%
Other	226	78%	3%	11%	2%	0%

- **Most fires have no impact on the grid**
- **A few fires have very large impacts**

We forecast changes to future T&D wildfire risk



Credits: Dale et al.; CEC
Envision Geo

Wildfire risk now highest along Southern California's coastal mountains.
Wildfire risk growing fastest in the Northern California mountains (U.C. Merced Model)

Finally, we evaluated selected adaptation options

Transmission

- Eliminate transmission
  - Micro grids
- Move transmission
  - to low fire risk areas
- Diversify transmission
  - Add widely spaced lines or underground lines in high risk areas
  - WECC transmission capacity is concentrated in some high fire risk areas

Distribution

- Eliminate distribution exposure
  - Buy up development rights in high fire risk zones (FEMA?)
  - Encourage urban infill, limit sprawl
- Underground lines

Research gaps

- Modeling Studies
- Adaptation Studies
- Integration Issues
- High Fire Risk Area Identification

Backup Slides

Distribution—rate fire impacts

LBNL rating system (360 fires)

		Distribution Impact Severity Level				
		1	**2**	**3**	**4**	**5**
		Low	**Medium**	**High**	**Severe**	**Catastrophic**
	(# fires)	No Fringe Burned	Partial Fringe Cell	Between 2-5 Fringe Cells	Between 6-10 Fringe Cells	Over 10 Fringe Cells
Northern California	103	*84%*	*5%*	*9%*	*2%*	*0%*
Southern California	257	*58%*	*12%*	*18%*	*5%*	*7%*

- **Most fires have no impact on the grid**
- **A few fires have very large impacts**

Source: GIS analysis applied to wildfire fringe data set (Cal Fire 2001-2016)

Total Cost of Fires?

Including cost of service interruptions, structural damage, alternative fire projections and 2017 update.

Cost (million USD annual)		
	Current	**Mid Century**
Total (low)		
Transmission	$84	$89
Distribution (Westerling 2018)	$975	$897
Total	**$1,059**	**$985**
Total (medium)		
Transmission	$84	$89
Distribution (Jin et. al 2015)	$975	$1,570
Total	**$1,059**	**$1,659**
Total (high)		
Transmission	$84	$89
Distribution (Jin et al 2015), plus 2017 headline fires	$1,682	$2,710
Total	**$1,767**	**$2,799**

(include est. cost of service interruption)

(include cost of structures)

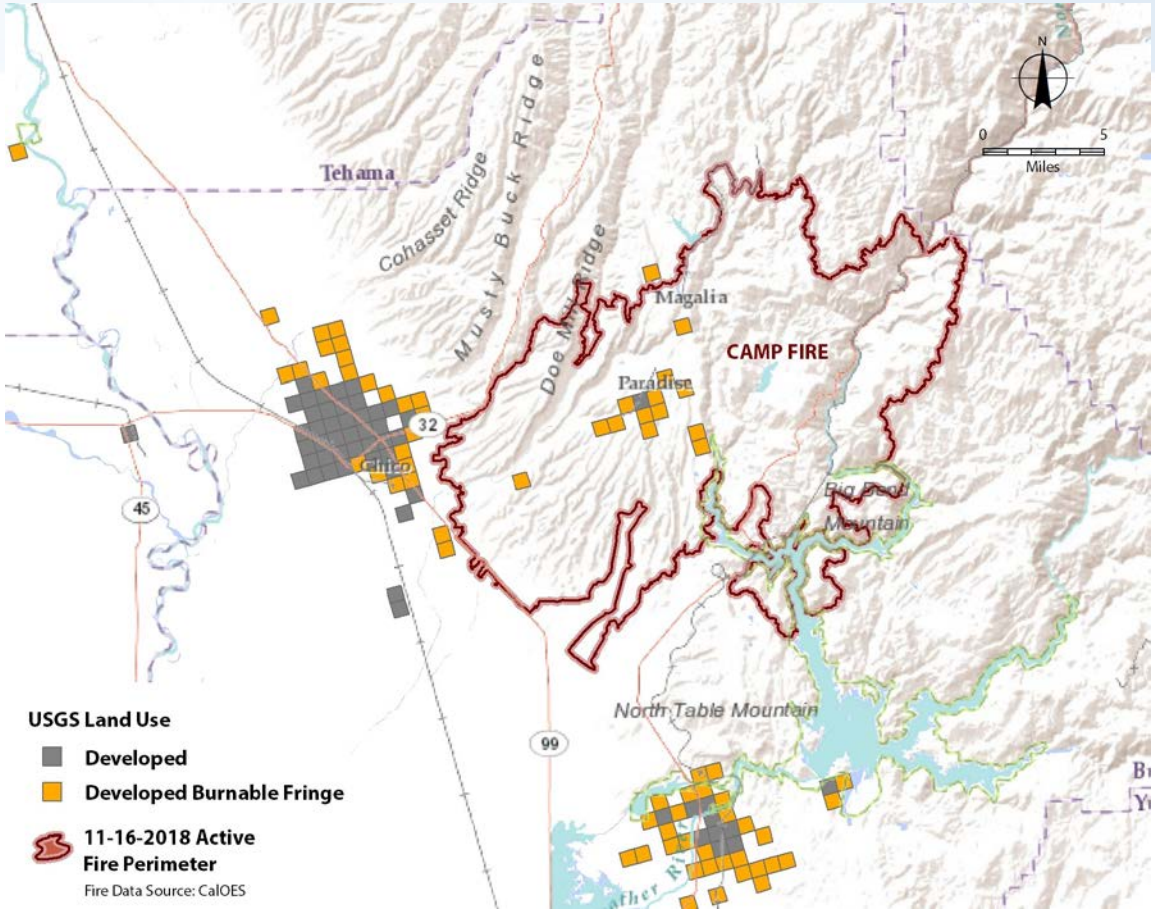
(Jin est. of rise in S. CA. wildfire area)

(including recent fires to data set)

Locate high risk wildfire locations

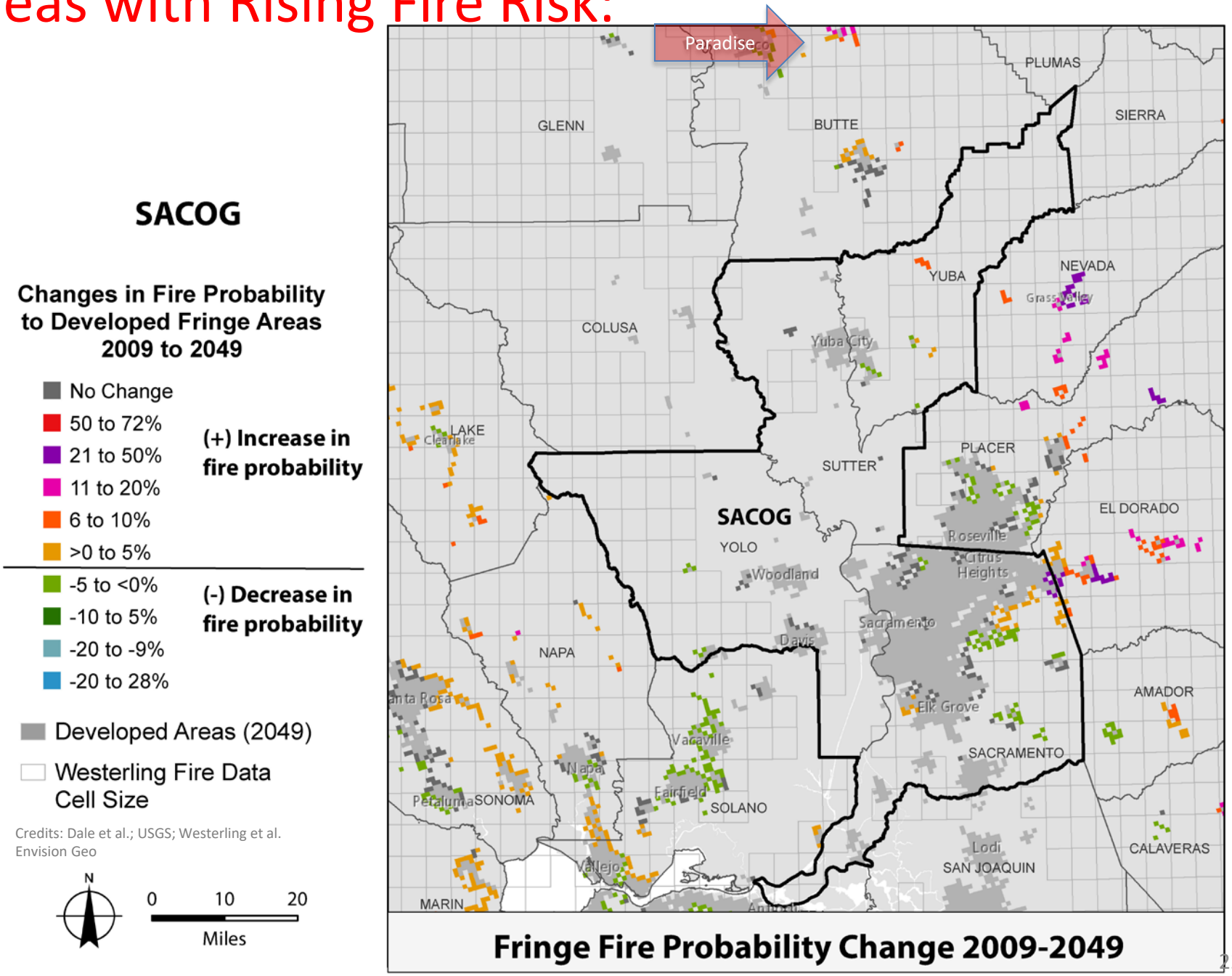
- Pressing need to flag high risk fire areas
- Red flags include urban areas with:
  - Rapidly rising wildfire risk
  - Located in regions with risk of Santana or Diablo events
  - Downwind of transmission lines
  - Low density, relatively high fringe cell counts

Low Density (extensive WUI)



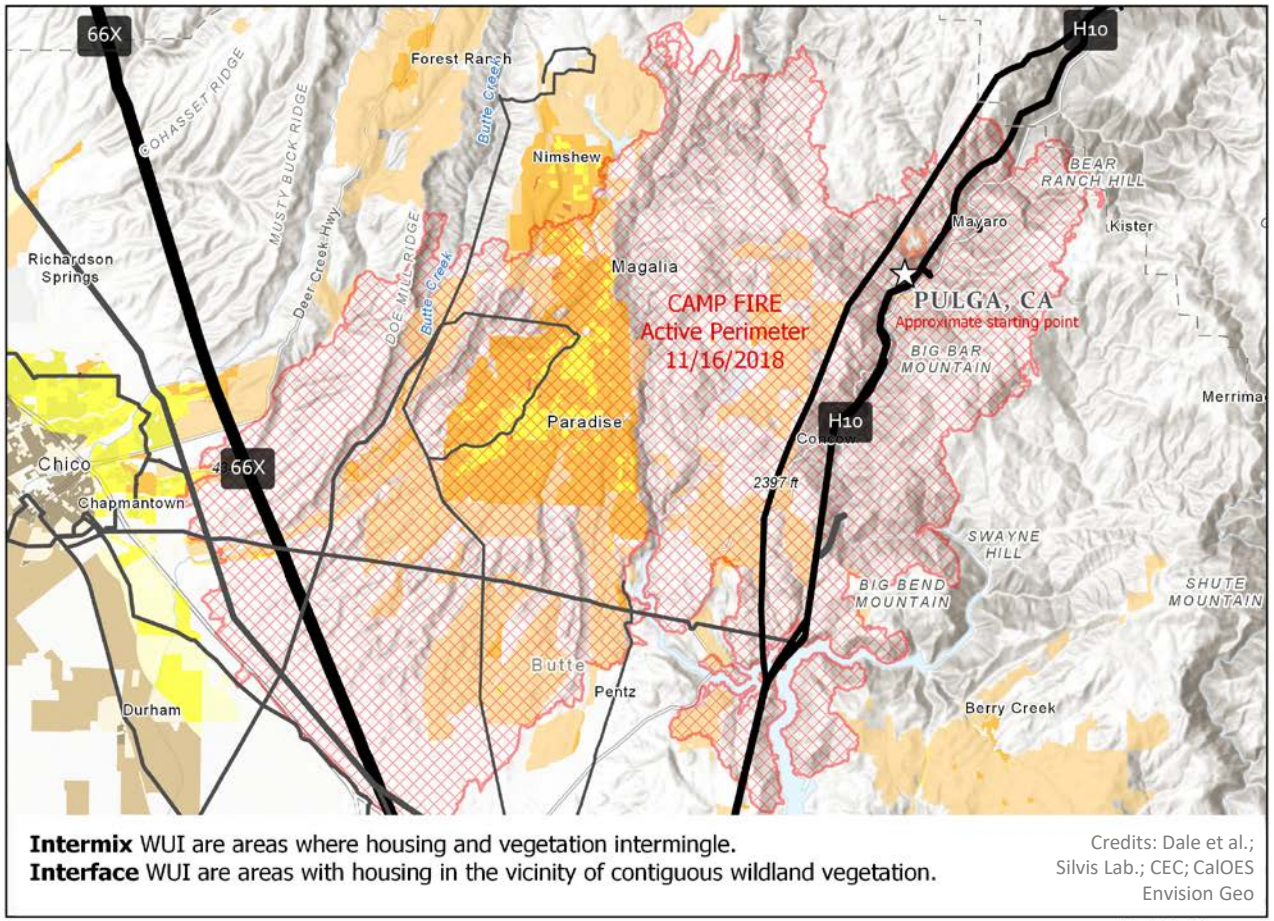
Credits: Dale et al.; USGS; CalOES
Envision Geo

Areas with Rising Fire Risk:



Transmission lines and wind

Camp Fire Active Perimeter, Wildland Urban Interface (WUI) & Major Transmission Paths



Modeling Studies

- Transmission
  - Additional modeling of wildfire impacts
    - Utility help with “extrapolation spreadsheet” assumptions.
    - Utility estimates of generation cost impact from fire related line outages.
    - Additional PLEXOS runs to better characterize costs impacts of wider range of interruption types, for more path locations and different time periods.
- Distribution
  - More detailed modeling of wildfire spread into urban core areas
    - More probabilistic modeling to explain why fires penetrate some cells and not others.

Adaptation Studies

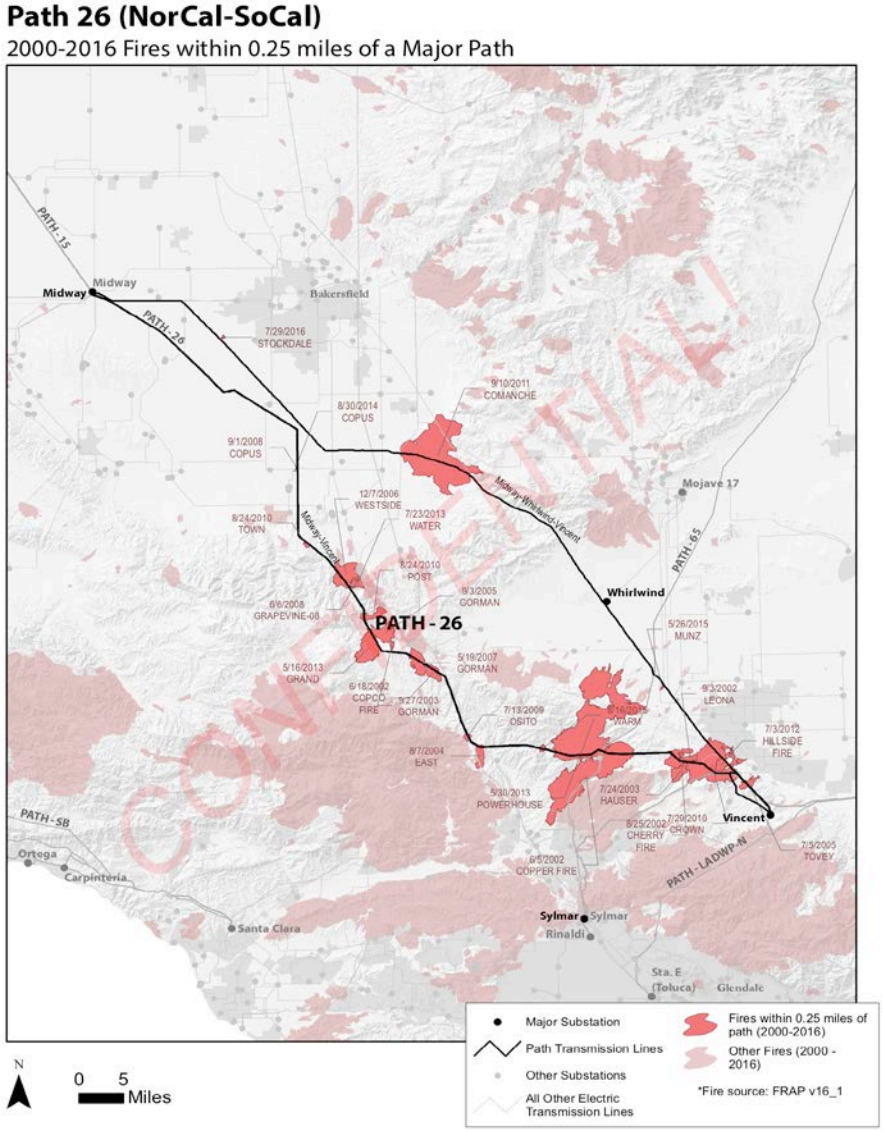
- Fire Adaptation studies
  - Fire resistant transmission
    - Locate paths that should be undergrounded or relocated.
      - Locate the most vulnerable paths to future wildfire damages.
      - Work with utilities and CAISO to determine the benefits of undergrounding (cost of transmission interruptions.
  - Fire Resistant WUI cells.
    - This is a natural extension of the fire spread modeling work. That work should help identify characteristics of WUI cells that successfully warded off past fires in nearby cells.
    - The work could be expanded to include more detailed information about the type of buildings in WUI cells that resisted past fires, and their value.
  - Fire Resilient Landscapes
    - Obviously, similar work is needed to help identify fire resistant landscapes and landscape treatments (e.g., controlled burns, forest thinning, irrigation).

Study Integration Issues

- Transmission-caused wildfires
  - It bears repeating that the grid itself impacts wildfires.
  - There may be good reasons for separating studies of fire impact to grid, from grid impacts to fires.
  - Some grid resilience options provide benefits that can only be counted by integrating these two types of studies (undergrounding).
- Wildfire model projections
  - Different wildfire models incorporate many uncertain variables:
    - Precipitation
    - Wind speed
    - Ignition (transmission and wind)
  - Gather and pool different fire model projections, perform scenario analysis of variables
    - Similar to climate model ensemble projections
    - Isolate the impact of key variables (wind vs temperature vs vegetation).

Model the cost impact

PLEXOS Example: Path 26

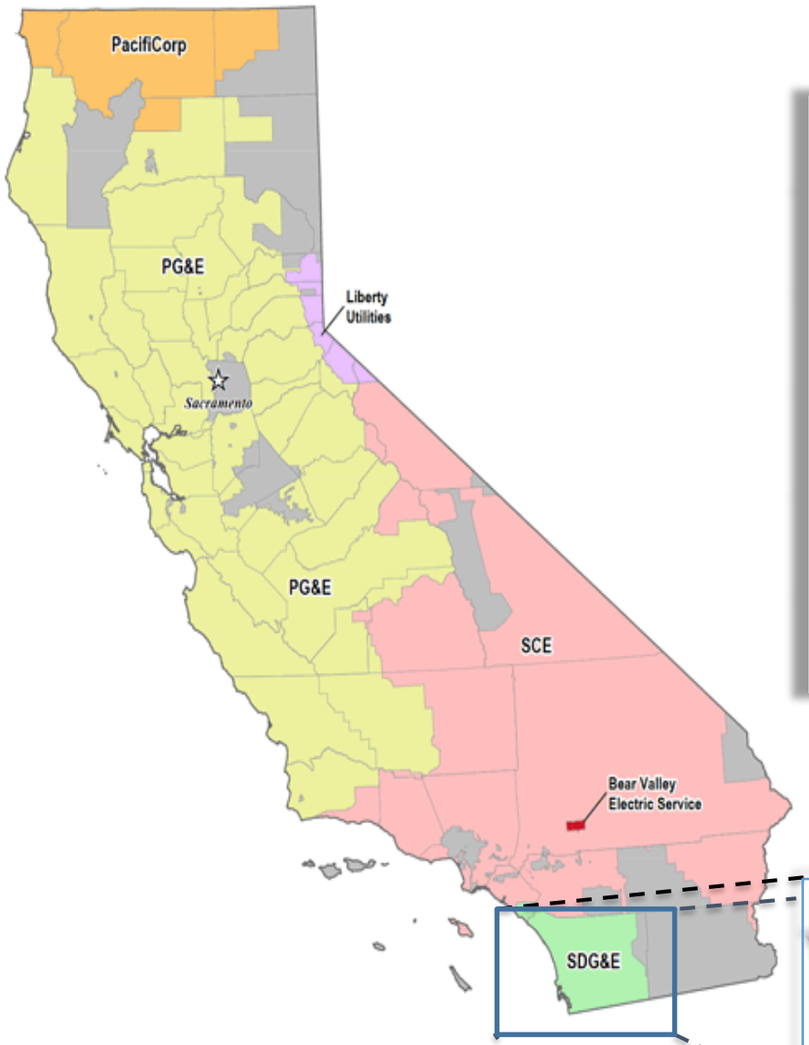


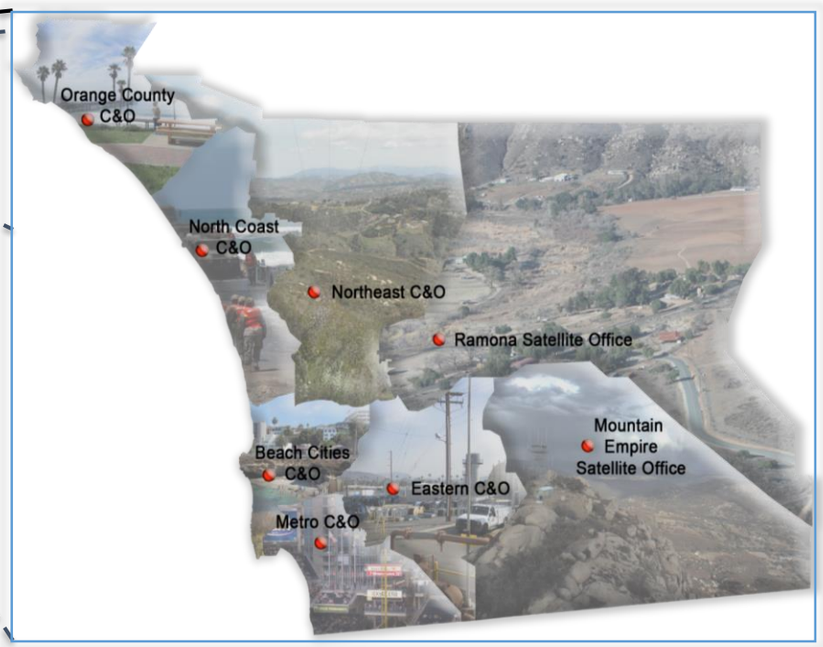
Linking northern and southern California grids

Credits: Dale et al. 2018.; FRAP; CEC Envision Geo

EPIC Symposium
SDG&E's Wildfire Preparedness
February 19, 2019

SDG&E Service Territory

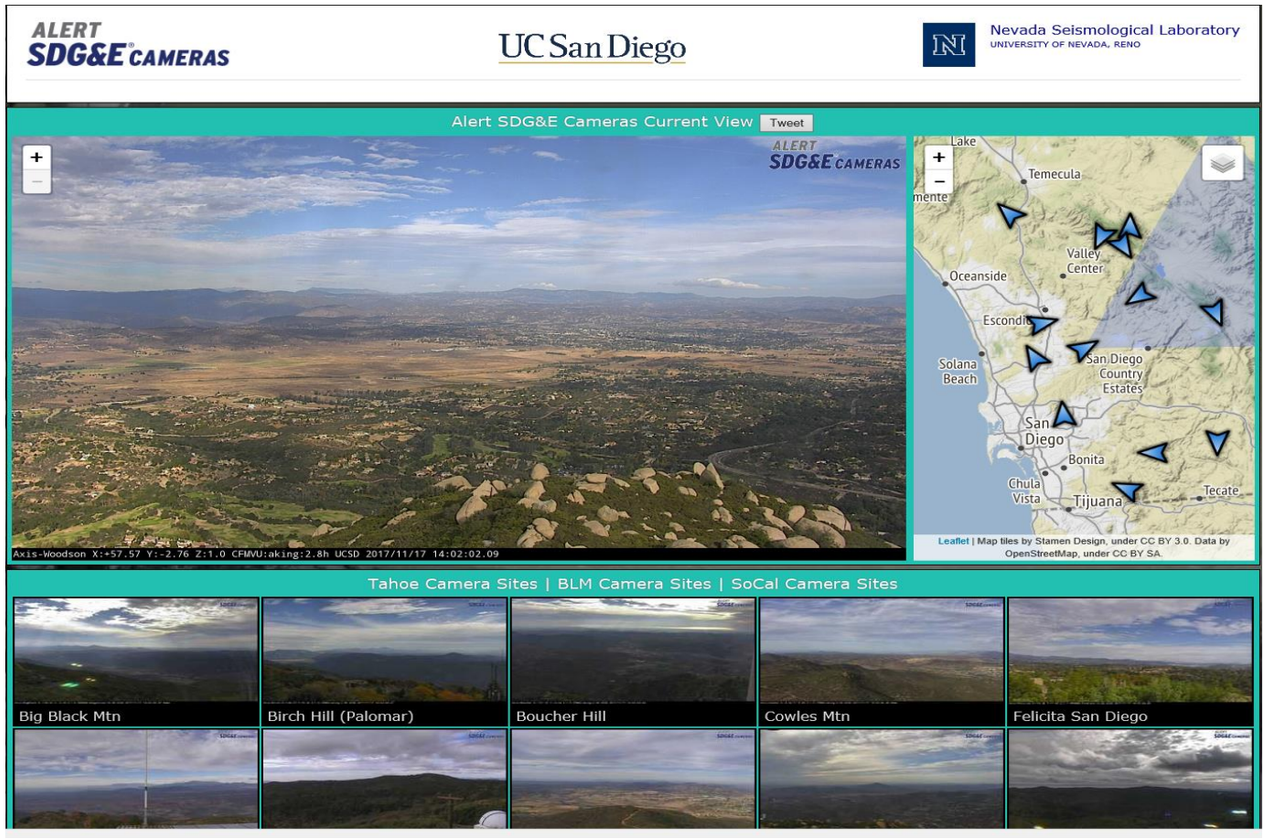


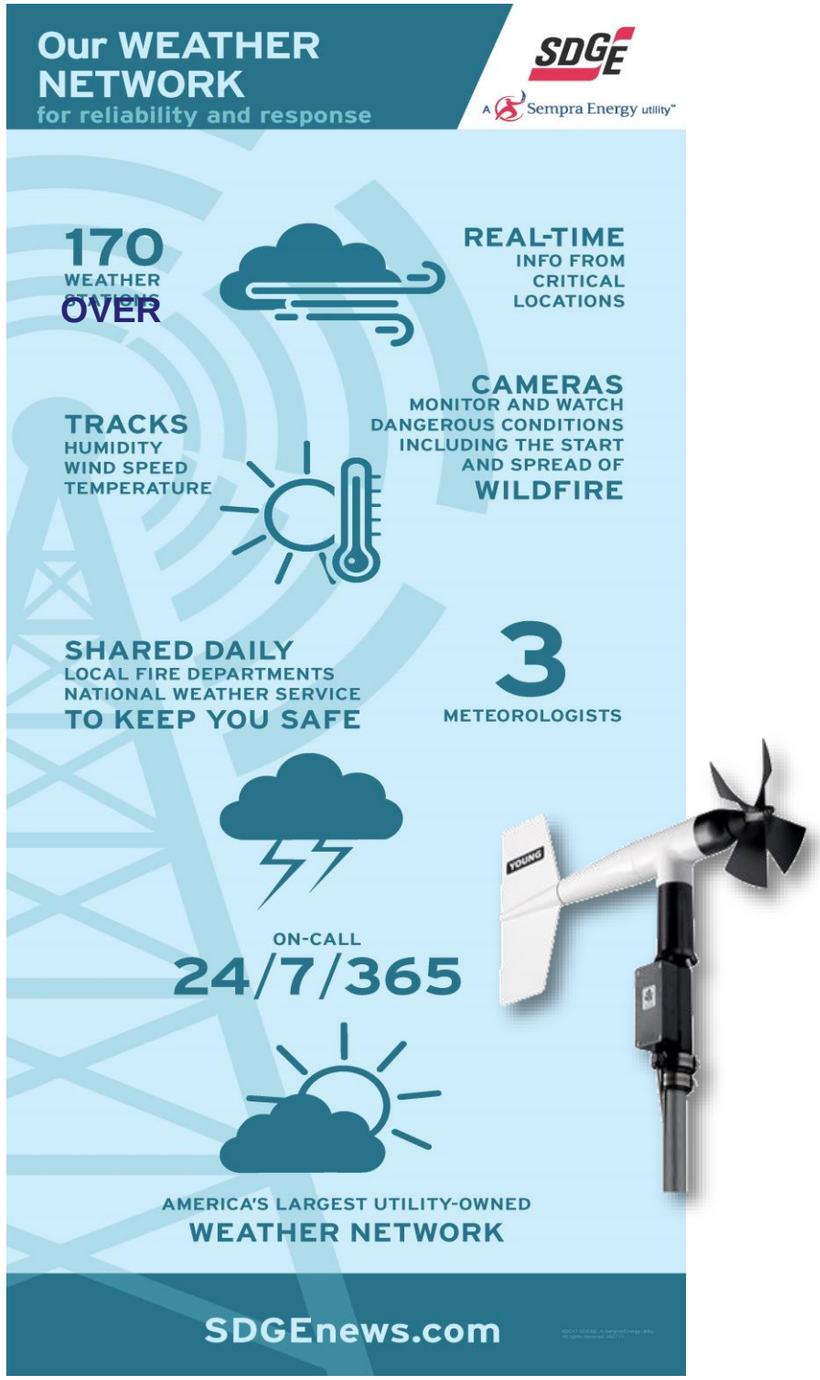


	Distribution	Transmission
Substations	136	20
Poles/Structures	208,970	14,330
Circuits	1,033	237
Circuit Miles	17,000+	1,970+
OH Circuit Miles	6,500+	1,800+

- 4,100 Square Miles
- ~2,350 Square Miles in High Fire Threat District (HFTD)
- 1.4 Million Electric Meters
- ~4,100 Employees

Premier Weather Network of 177 Weather Stations





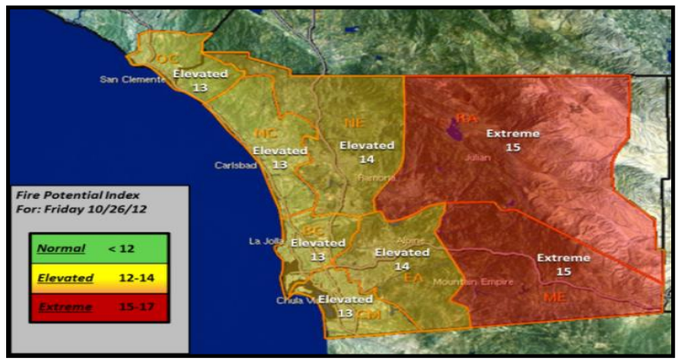
- SDG&E operates America's most granular utility-owned weather network with over 200,000 pieces of weather data collected daily
- Future steps include additional installations in coastal canyons and Wildland Urban Interface areas
- Weather stations in high risk areas are being rebuilt with latest technology
- Over 100 high definition cameras improve fire detection with 16 Pan-Tilt-Zoom Alert SDG&E cameras in service and additional installations planned for 2019

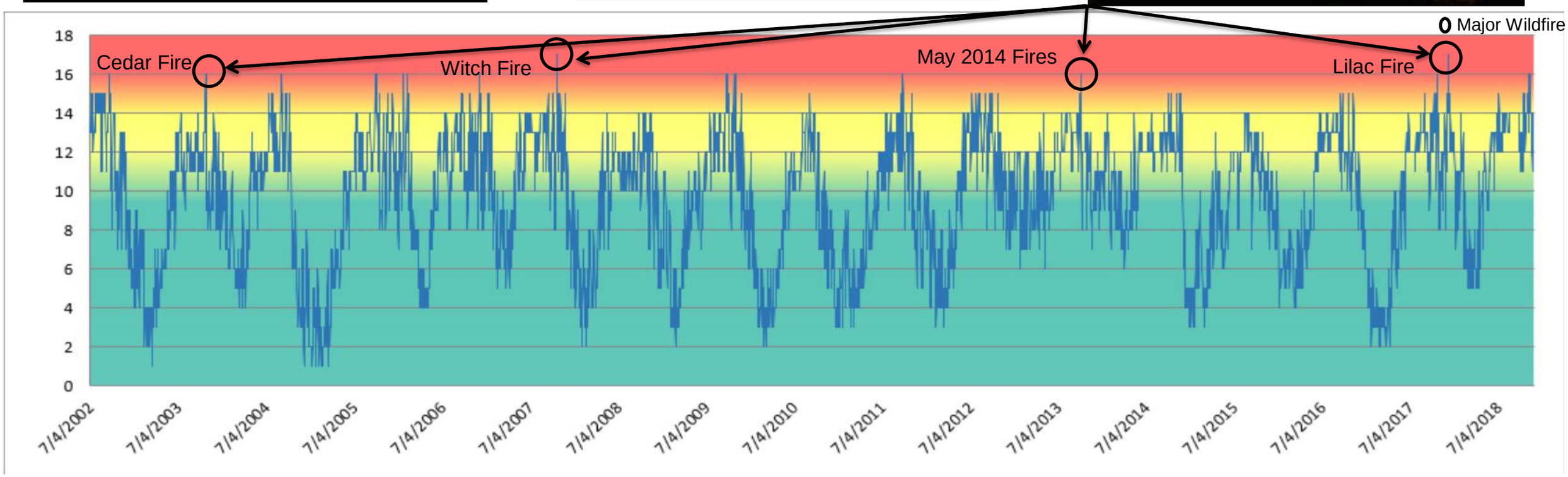
Fire Potential Index (FPI) Enables Greater Risk Understanding

A planning and decision support tool, which has been back-tested, developed by SDG&E to communicate the wildfire potential on any given day, classifying the fire potential within each of its 8 operating districts

- A seven-day forecast product, produced daily
- Incorporates weather, live fuel moisture, dead fuel moisture, and greenness of the annual grasses
- Used to inform operational decisions, work restrictions, resource allocation

	Thu 10/25	Fri 10/26	Sat 10/27	Sun 10/28	Mon 10/29	Tue 10/30	Wed 10/31	Thu 11/01
ME	Normal 11	Extreme 15	Elevated 13	Elevated 12	Normal 11	Normal 11	Normal 11	Normal 10
RA	Normal 11	Extreme 15	Elevated 13	Elevated 12	Normal 11	Normal 11	Normal 11	Normal 10
EA	Normal 10	Elevated 14	Elevated 12	Normal 11	Normal 11	Normal 10	Normal 10	Normal 10
NE	Normal 10	Elevated 14	Elevated 12	Normal 11	Normal 11	Normal 10	Normal 10	Normal 10
OC	Normal 10	Elevated 13	Normal 11	Normal 11	Normal 10	Normal 9	Normal 9	Normal 9
NC	Normal 10	Elevated 13	Normal 11	Normal 11	Normal 10	Normal 9	Normal 9	Normal 9
BC	Normal 10	Elevated 13	Normal 11	Normal 11	Normal 10	Normal 9	Normal 9	Normal 9
CM	Normal 10	Elevated 13	Normal 11	Normal 11	Normal 10	Normal 9	Normal 9	Normal 9





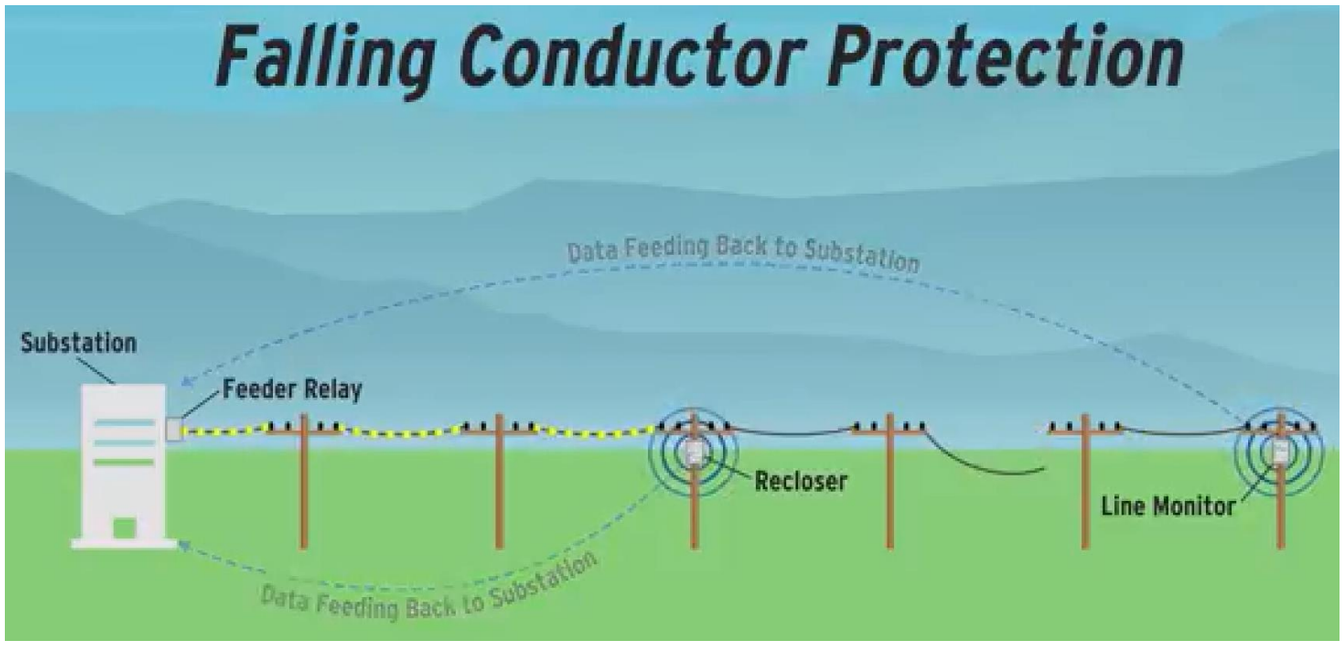
Advanced Electric System Protection

Protection Philosophy

- Three types of protection functions in SDG&E's automated reclosers:
  - Normal Profile: Protects circuits under normal conditions.
  - Sensitive Profile: Relay is very fast and incredibly sensitive in order to isolate faults faster than normal profile.
  - Sensitive Ground Fault: This setting detects high impedance faults which largely result from downed conductors.

Protective Devices

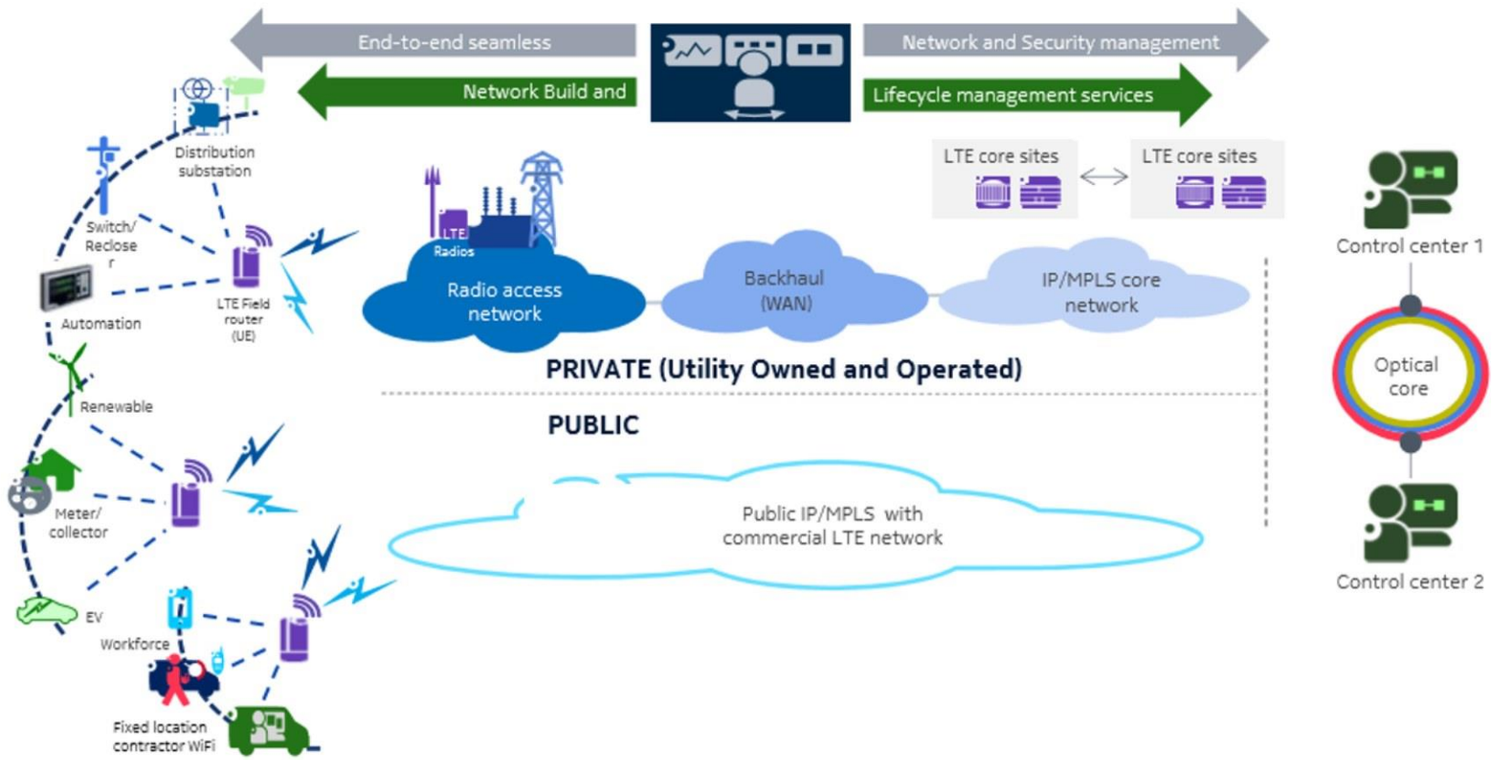
- **Sensitive Profile** and **Sensitive Ground Fault** Protection
  - Over 270 distribution circuit automated reclosers in the HFTD have the capability for sensitive profile and sensitive ground fault protection
- **Falling Conductor Protection**
  - Developing technology to de-energize conductors prior to hitting the ground
  - As part of SDG&E's fire hardening efforts, devices are being installed to enable the future deployment of falling conductor technology



Private LTE Communications

Developing a wireless communication infrastructure for increased reliability and system coverage, enhanced security, and remote access capabilities.

- Providing wider system coverage allowing for additional remote intelligent devices to manage the grid
- Improved network availability and reliability for mobile workforce and electric and gas infrastructure
- Increased network bandwidth allowing for remote access of electric equipment and reduction in truck rolls
- Enhanced cyber security capabilities for remote management and automation
- Standardized technology that enables of grid services and expanded network coverage (Falling conductor, SCADA, Push to Talk, DERMS, Microgrids, DER, etc.)



Questions?

EPIC Symposium

Wildfire Prevention Technologies

February 19, 2019

Energy for What's Ahead℠

SOUTHERN CALIFORNIA EDISON®

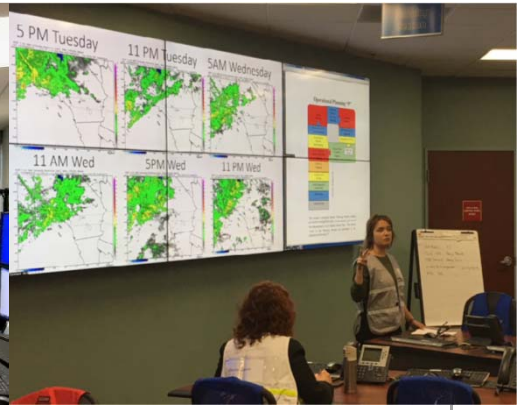
SCE wildfire mitigation efforts combine long-standing practices with additional enhancements

Long-Standing Operational Practices

Investing in System Hardening of Electric Grid

Bolstering Situational Awareness Capabilities

Enhancing Operational Practices



Mitigation Strategy is Based on Fire Science

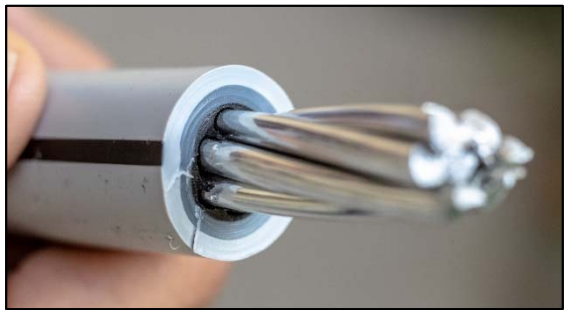
Weather Conditions (Wind, Humidity)

Energy from Electrical Infrastructure

Vegetation & Structures

Eliminating Any Side of the Fire Triangle Prevents Ignitions

Investing in System Hardening



Covered Conductor

Faster-Acting Fuses & Reclosers

Fire Resistant Poles

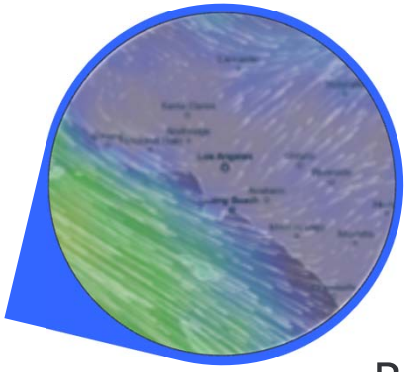
Bolstering Situational Awareness Capabilities

Weather Stations

- Hi-Res Data
- Local Weather

Situational Awareness Center

- 24/7 monitoring
- SCE meteorologists



Advanced Weather Modeling

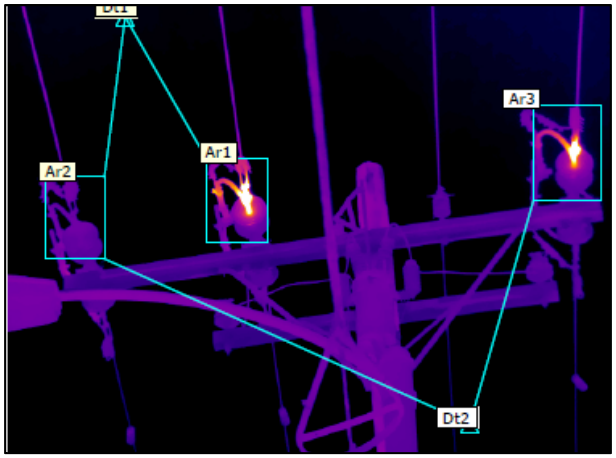
- Better Forecasting
- Advanced Warning

Fire Monitoring Cameras

- High-Definition
- Remote-controlled

Fire Cameras: www.alertwildfire.org

Enhancing Operational Practices



Infrared Scanning

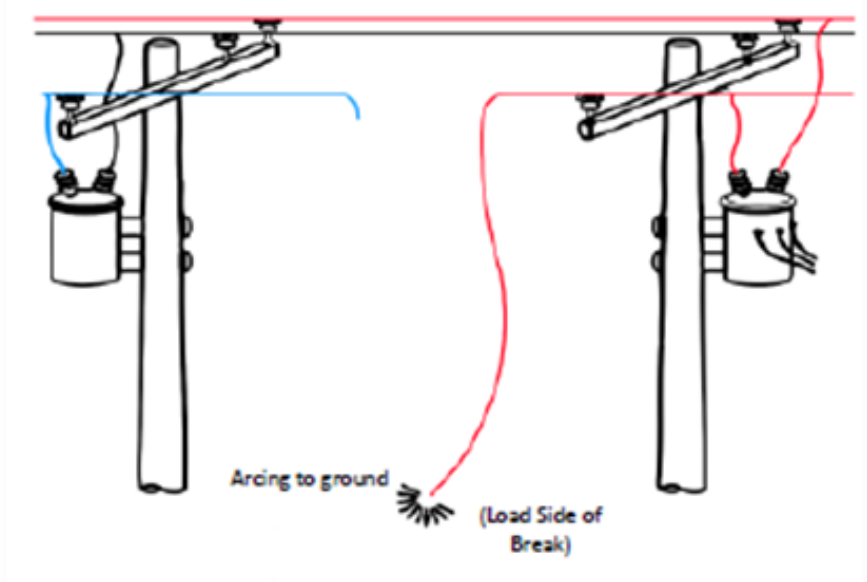
Vegetation Management

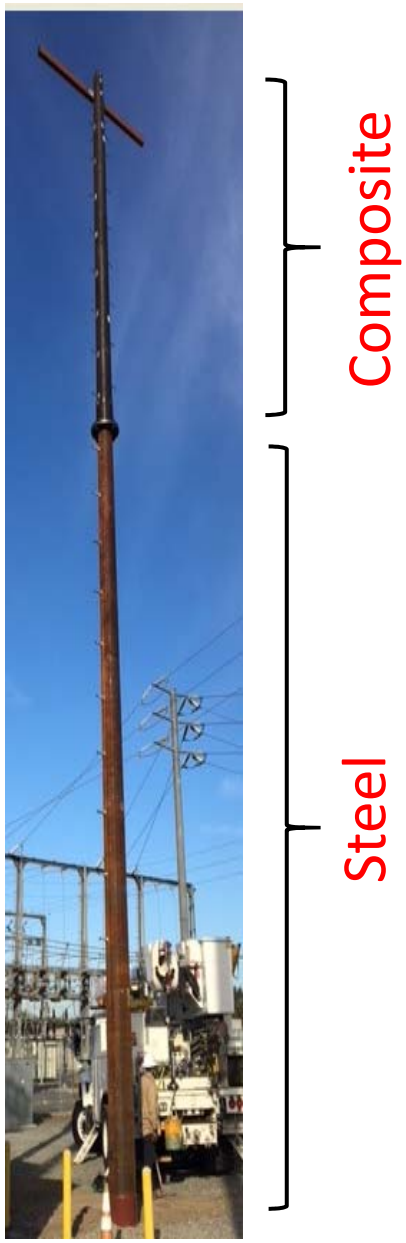
Public Safety Power Shutoff

Protective Device Settings

EPIC Demonstration

Intelligent Modern Pole
(Possible EPIC)





Downed Conductor Mitigations

Next Generation Distribution Automation - SSTDR (EPIC)
Meter Alarming of Downed Energized Conductor (not EPIC)

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Lunch Session is Currently in Progress

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EPIC SYMPOSIUM

Enabling Localized Clean Energy Portfolios

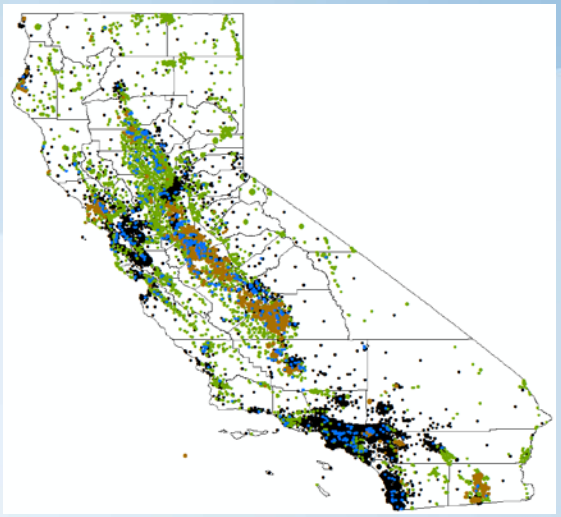
Moderator: **Max Gomberg**

Presenters: **Dr. Hanna Breunig**, **Thomas Gratz**, **Logan Olds**, **Dr. Sebastien Tilmans**, **Mark McDannel**

CEC EPIC Project: Advancing Cleaner, Less Costly, More Reliable Distributed Generation to Enable Customer Solutions and Zero-Net Energy Communities

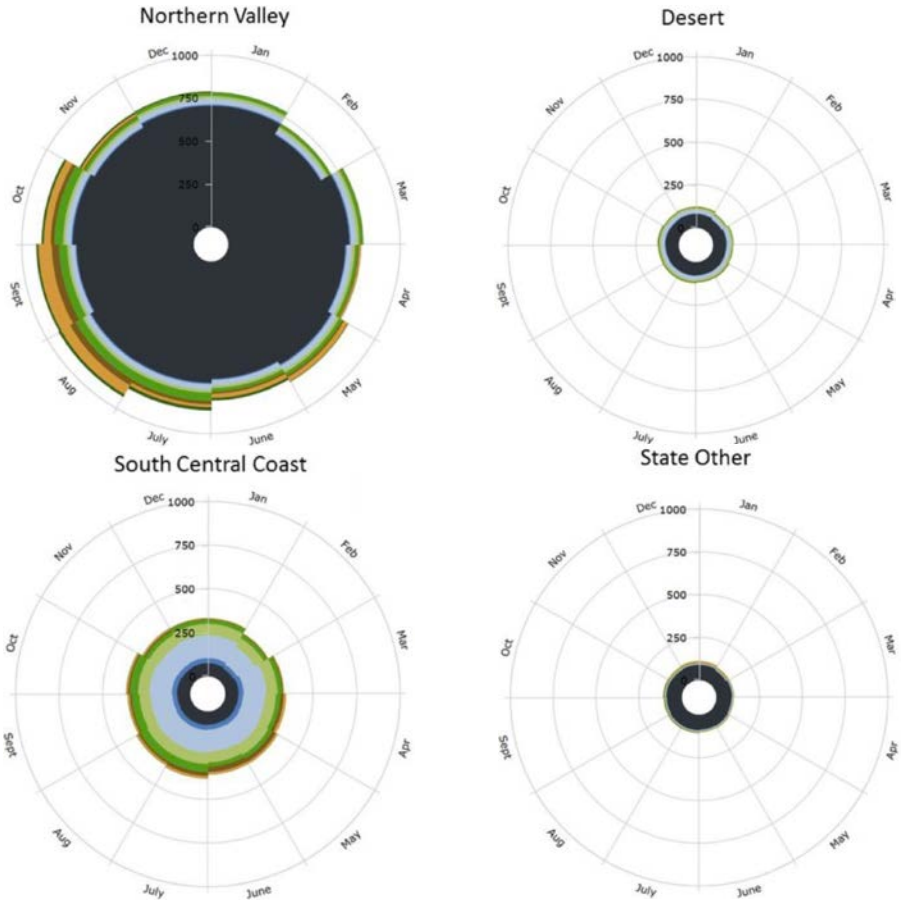
Lawrence Berkeley National Laboratory
Corinne Scown, Staff Scientist, Project PI
Alastair Robinson, Program Manager, Project Co-PI
Hanna Breunig, Research Scientist
Ling Jin, Project Scientist

Partners and Supporters:
Allotrope Partners
PepsiCo
Everycs
International District Energy Association



High-Moisture Solids (thousand BDT/yr)

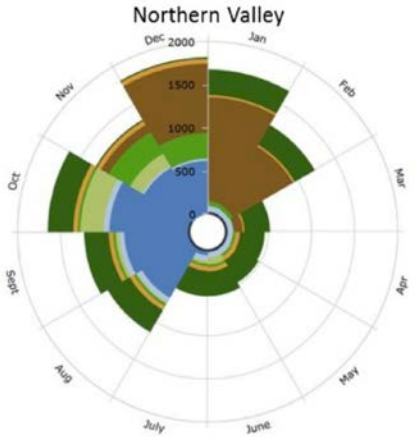
- Orchard & Vineyard Culls
- Row Crop Culls
- Row Crop Residue
- Processor High Moisture Solids
- Food/FOG MSW
- Other MSW
- Biosolids
- Manure

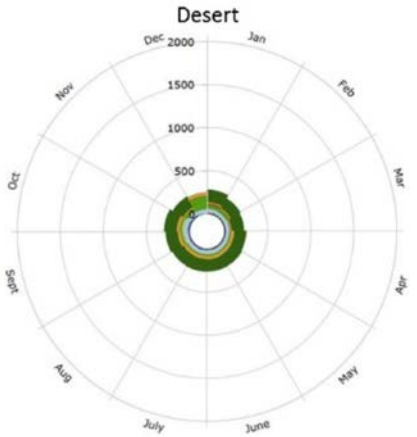


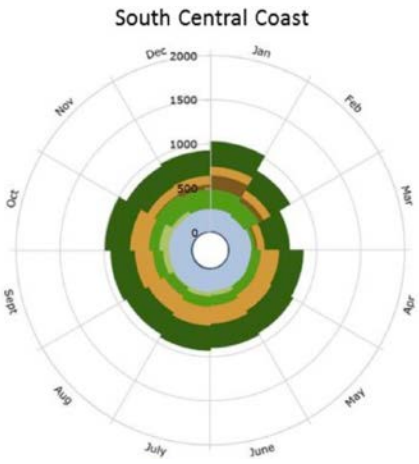
- High-moisture solids are fairly consistent month-to-month and dominated by manure
- Next largest contributor is MSW
- Row crop culls, high-moisture crop residue, and food processor waste are more seasonal
- MSW concentrated in populous South Central Coast region
- Manure concentrated in Northern Valley region

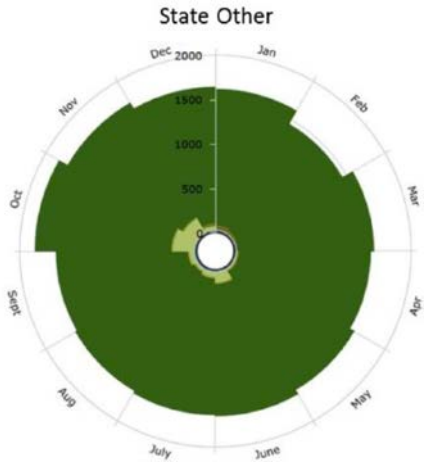
Low-Moisture Solids (thousand BDT/yr)

- Forestry
- Lumber MSW
- Orchard & Vineyard Residue
- Municipal Green
- Field Agricultural
- Cardboard/Paper MSW
- Processor Low Moisture Solids
- Animal Bedding





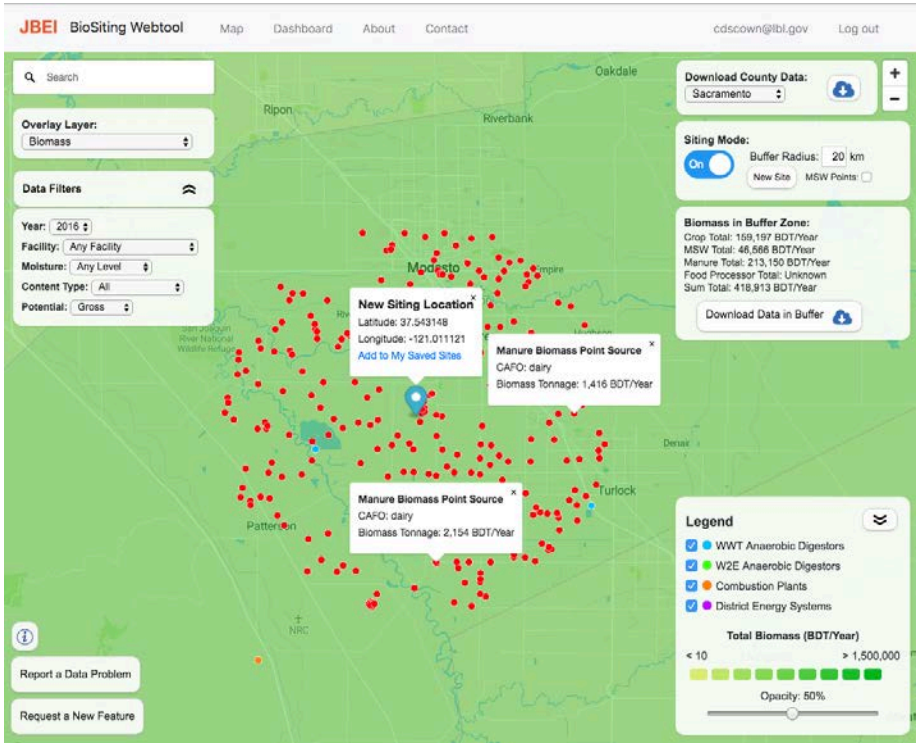




- Forestry residue is likely to dominate low-moisture organic residue availability
- Orchard & vineyard residue and food processor low-moisture waste next largest contributors
- Processor low-moisture solids made up largely of almond waste
- Seasonality less problematic for low-moisture waste but does require storage

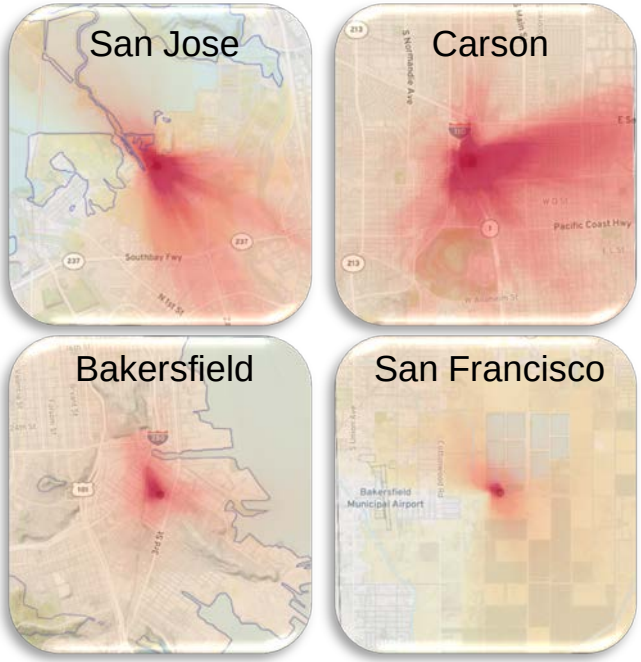
Assembling & Disseminating Actionable Information

- We aim to house the datasets generated in easy-to-access or visualize, centralized locations



biositing.jbei.org

Smelly: an odor dispersion web-tool to support odor assessment and AD siting decision



https://tin6150.github.io/smelly

SANITATION DISTRICTS OF LOS ANGELES COUNTY

Food Waste Recycling Program

Mark McDannel

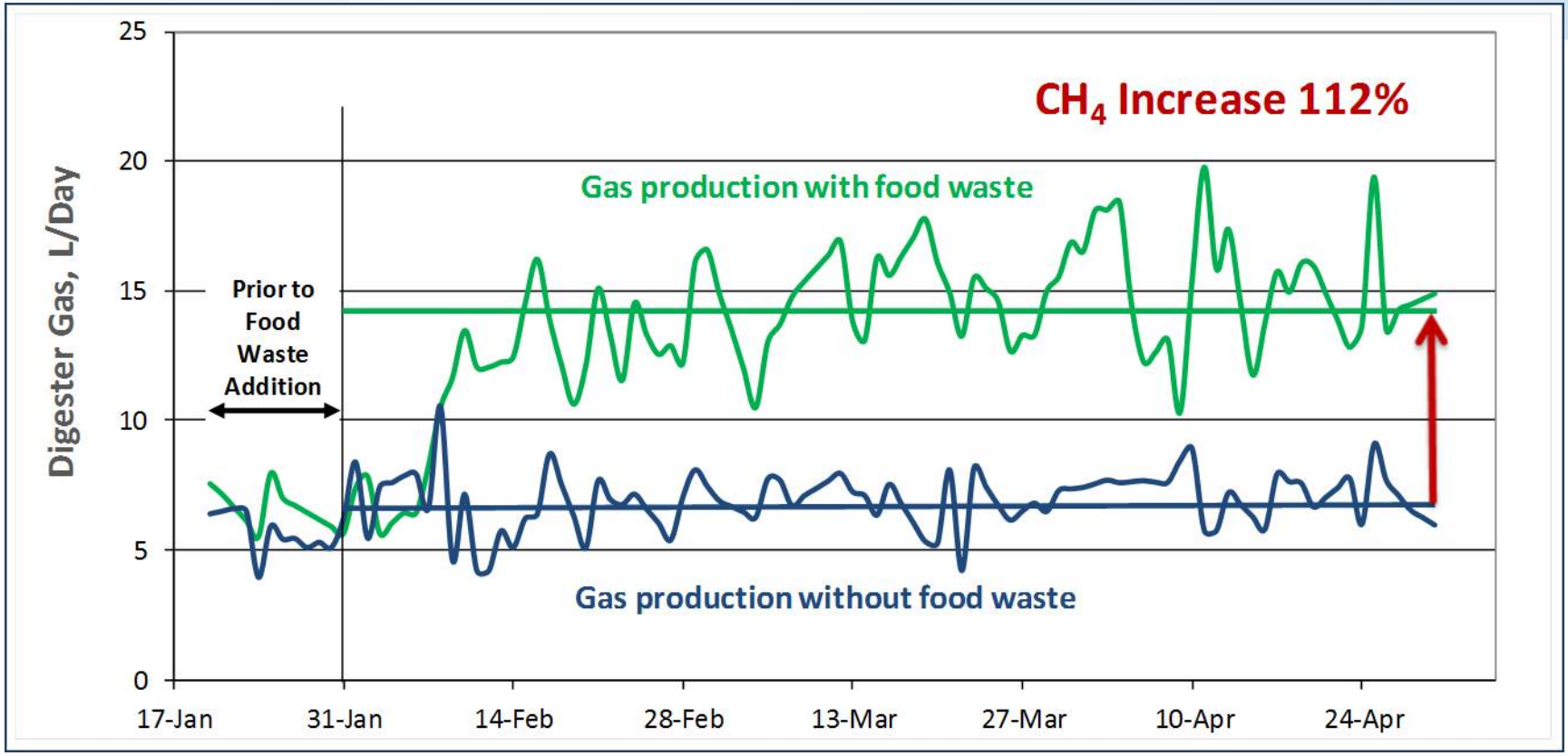
Los Angeles County Sanitation Districts

EPIC Symposium

February 19, 2019

Basic Research on Co-digesting Food Waste and Sludge 2011-2012

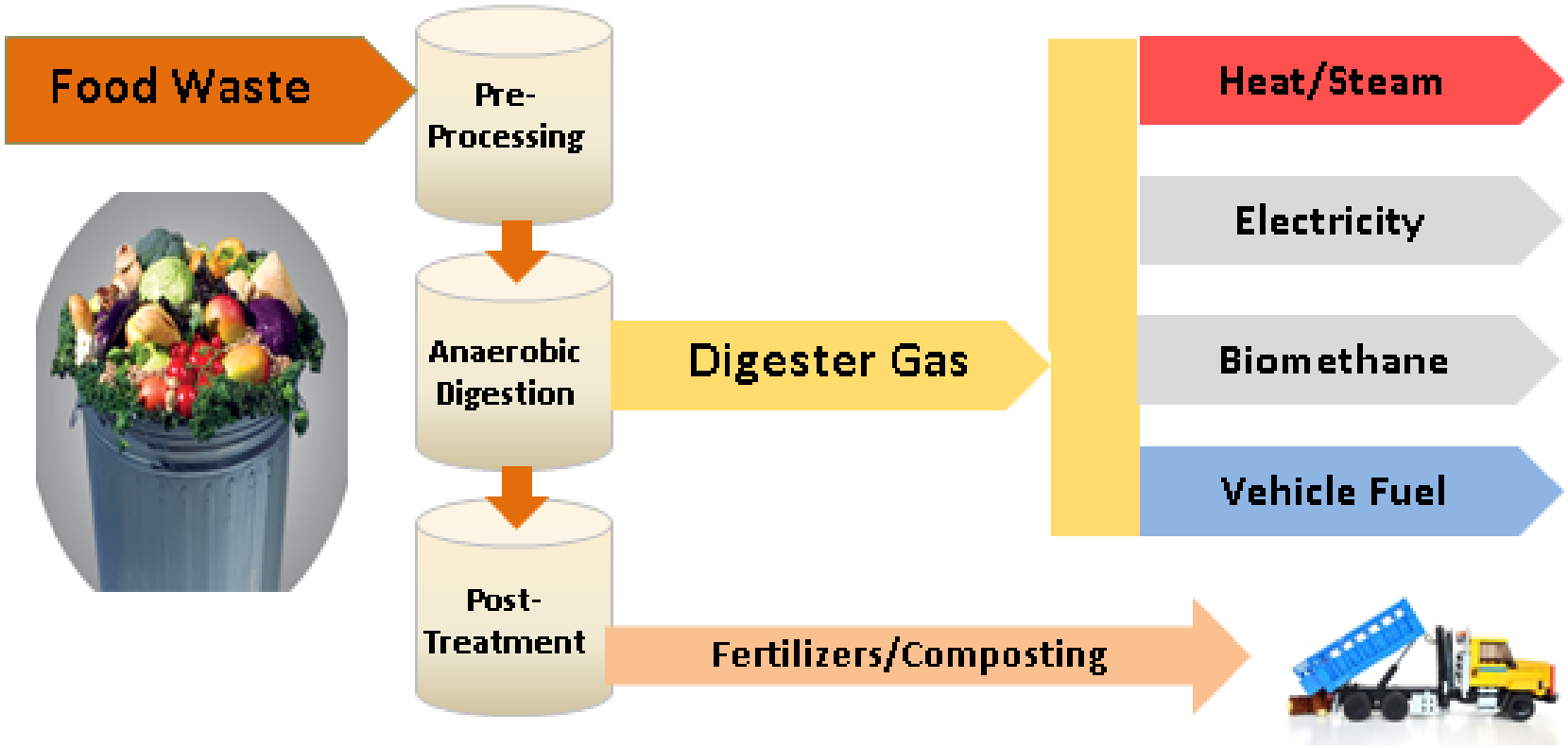
Quantified Potential for Methane Production



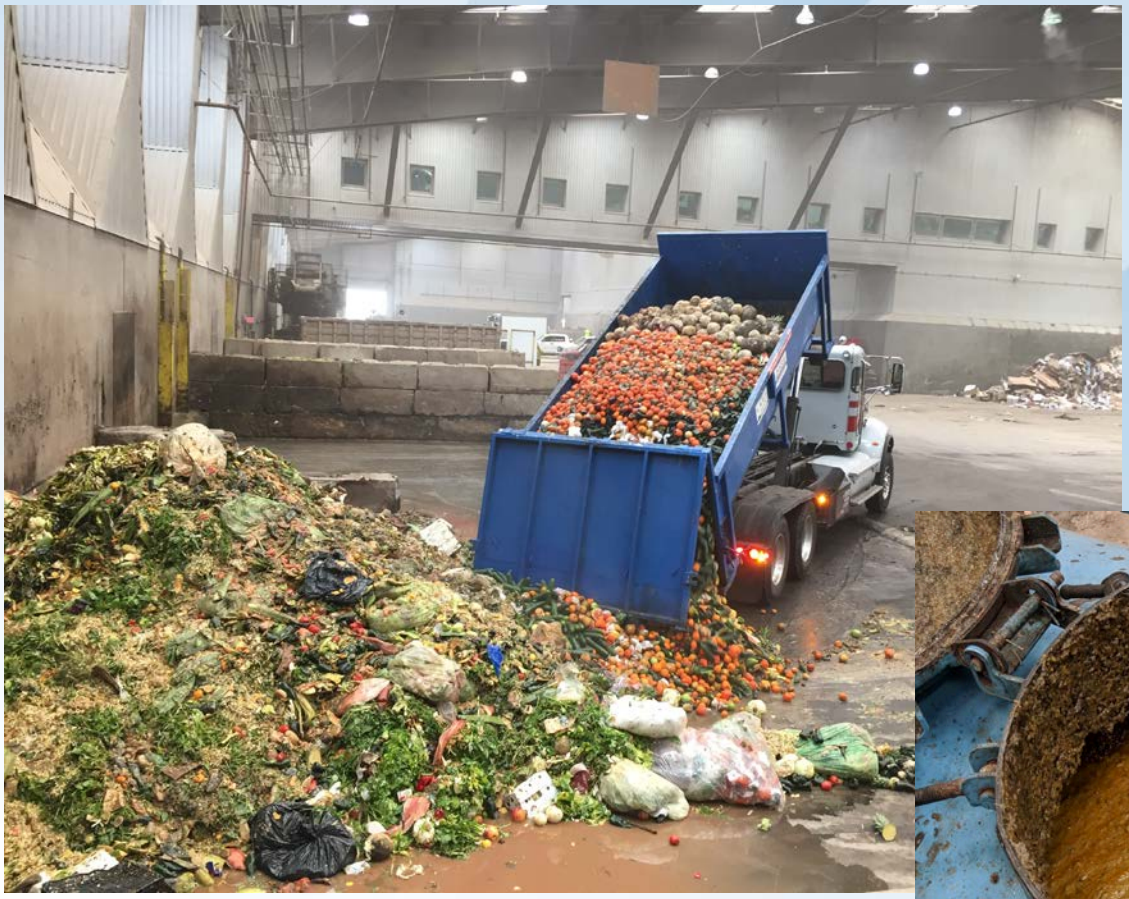
Adding 10-12% (v/v) food waste slurry to sludge could <u>double</u> biogas production

Food Waste Slurry characteristics: Total Solids ~ 14% by wt., Volatile Solids ~ 92% by wt., COD ~ 222,400 mg/L

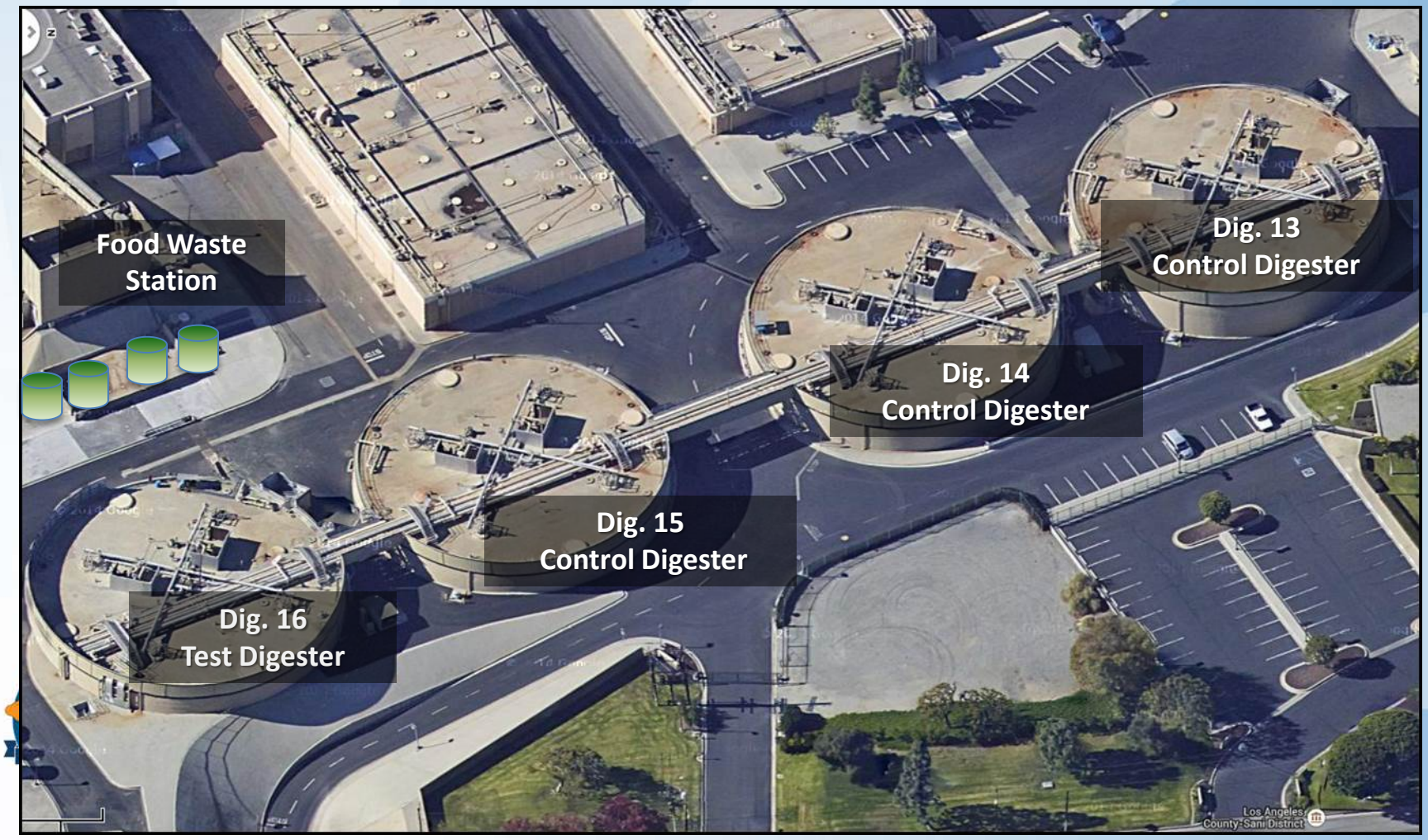
Demonstration and Commercialization Phases 2014-2020



Pre-processing Facility Started up 2018

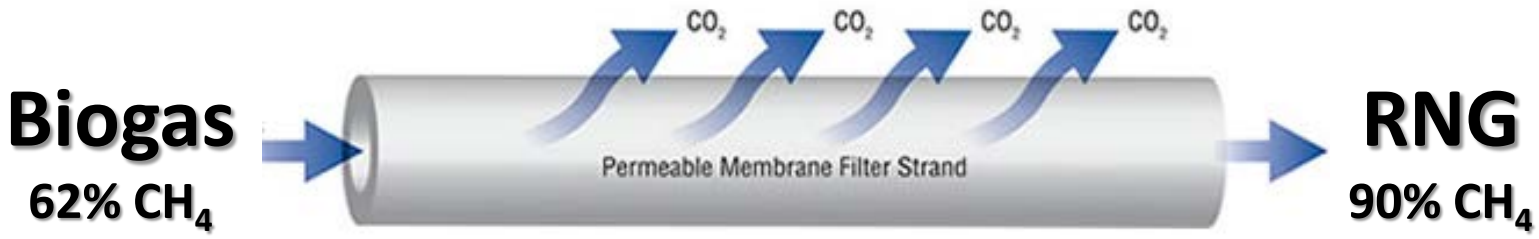


Full Scale Demonstration 2014-2018



Conversion of Digester Gas to Vehicle Grade CNG 2020

- Single-pass membrane filtration system to integrate with existing CNG station to utilize 100% biogas
- Produce up to 2,000 GGE's per day of RNG @ the CNG Station



Hitachi Zosen INOVA

EPIC Symposium 2019

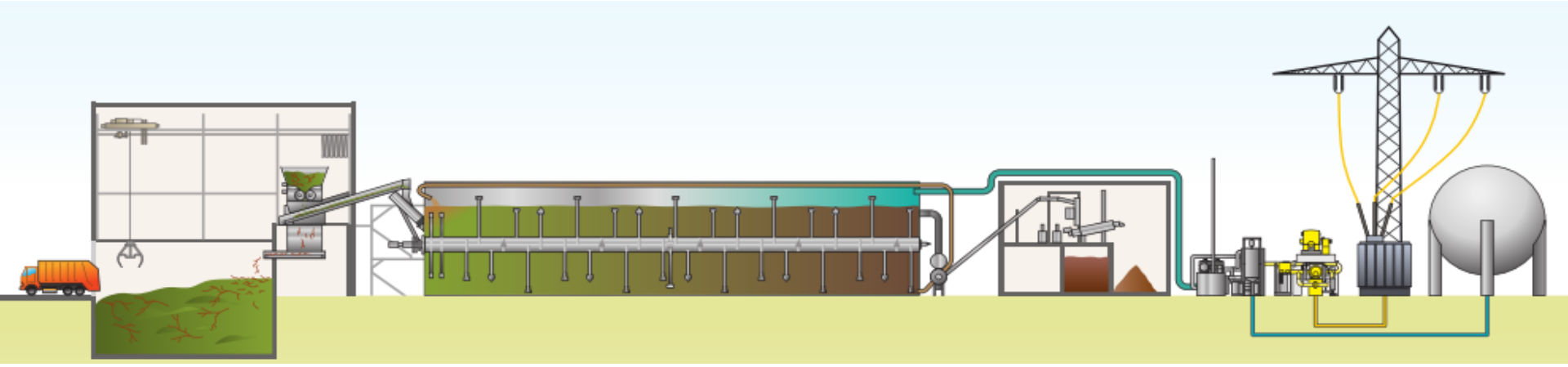
San Luis Obispo AD Project

Executing a 36,500 TPY Food And Green Waste AD Facility in California

Key Data

Technology	• Kompogas HSAD System with CHP for power production
Project Type	• FDBOO (Finance, Design, Build, Own, Operate) • First Kompogas Reference Plant in US
Project Cost	• ~25 M$ (incl. Project Development) with Power only concept • Financing through HZI and federal/state grants
Subsidy	• Grants: CalRecycle, CEC EPIC, CAEATFA) • ITC program (Investment Tax Credit)
EPC	• HZIU (expected project duration 15 months)
O&M	• Kompogas SLO LLC (duration 20 years)
Customer	• Waste Connection with its Subsidiaries
Feedstock	• 36,500 tons/year
Property	• Owned by WC Subsidiary – leased by Kompogas SLO LLC • Existing Building modified to fit overall plant concept
Compost & Liquid Digestate Sales	• Compost to be sold into local agricultural market • Liquid digestate as soil amendment for local farming

KOMPOGAS® - High Solids Plug Flow AD
First class technology combined with HZI turn-key capability



Proprietary Technology from HZI

Engineered by HZI

Managed by HZI

Project, Site and Construction Management

Feeding System	Digester	Discharge System	Dewatering	Gas Utilization

Electrical, Instrumentation and Controls

Balance of Plant and Energy Utilization

Site and Building Services

Civil

Integrated Solution

Maximized Efficiency

Reliable Execution

Projected Milestones

- Major construction completed July 2018
- Hot commissioning – commenced August 2018 with inoculation of digester
- First feeding late September 2018
- Facility on line since December 2018.

Kompogas SLO AD Facility

EPIC
SYMPOSIUM

Networking Break
and
Poster Session

EPIC SYMPOSIUM

Resilient and Equitable Communities

Moderator: **Commissioner Martha Guzman Aceves**

Presenters: **Michelle Tirto**, **Ram Narayanamurthy**, **Andy Brooks**, **Dr. Peter Alstone**, **Madeline Stano**

Just Transition

Madeline Stano
@MadStano
madelines@greenlining.org

Just Transition

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STATE OF CALIFORNIA
ENERGY COMMISSION

Optimizing Water Heating Performance for Multifamily ZNE

Andy Brooks · Director of West Coast Operations, AEA

February 14, 2019

Demonstration Sites

Calistoga Family Apartments

Cloverdale Family Apartments

Benner Plaza

Atascadero Family Apartments

ENERGY COMMISSION

Calistoga HVAC+ DHW System

Cloverdale HVAC+ DHW System

Atascadero DHW System

Benner DHW System

Property Characteristic Summary

Project Name	# of buildings	# of units	# of stories	# of bedrooms	CZ	Targeted pop.
Calistoga Family Apartments	1	48	2	1-3	2	30-60% AMI
Cloverdale Family Apartments	1	31	2	2-3	2	30-60% AMI
Atascadero Family Apartments	2	59	2	2-4	4	30-60% AMI
Benner Plaza	1	66	3/podium	1-3	4	30-60% AMI

New Project: To Launch Q2-2019

Mass Deployment Model for ZNE Retrofits

Thank You

Solar+ for Small and Medium Commercial Buildings

CEC EPC 17-002

Peter Alstone
Schatz Energy Research Center
Humboldt State University

February 19, 2019
CEC EPIC Symposium

Core Project Partners:
Schatz Energy Research Center at Humboldt State University

Lawrence Berkeley National Lab

Blue Lake Rancheria

Can we make microgrids streamlined and affordable for small sites with high resilience value?

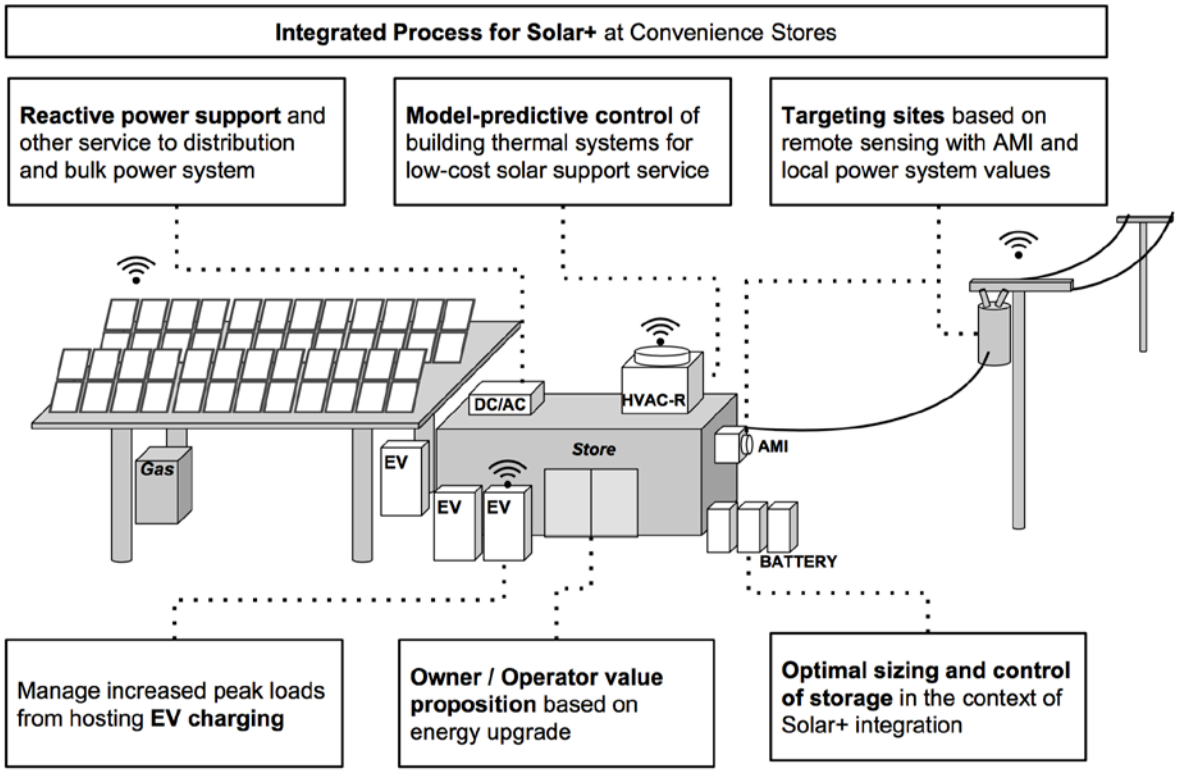
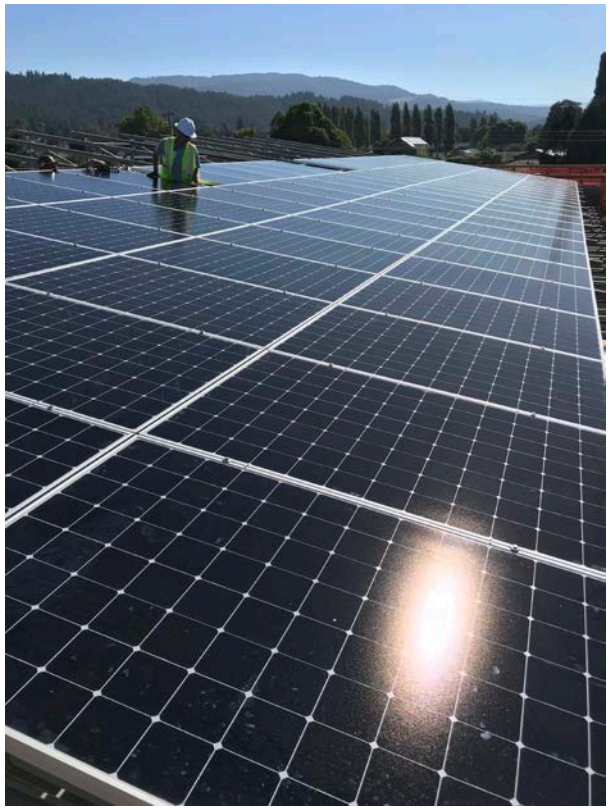


Figure 1: Illustration of integrated research objectives for Solar+ at convenience stores



Major Research Tasks

- **Design and construct** solar (60 kW), battery (109 kW/174 kWh), and controls upgrades
- **Design and implement software** for Model-predictive control and integrating building and electrical systems
- **Operate facility** to test demand response and resilience performance
- **Market research** on ubiquitous SMB, and focus on convenience stores
- **Synthesis** of work on hardware, software, and market

Blue Lake Rancheria

Clean energy deployment leadership

Solar+ at the Playstation C-store

Award winning 500 kW microgrid project (foreground)

Distributech 2018 Project of the Year Award

FEMA's 2017 Whole Community Preparedness Award

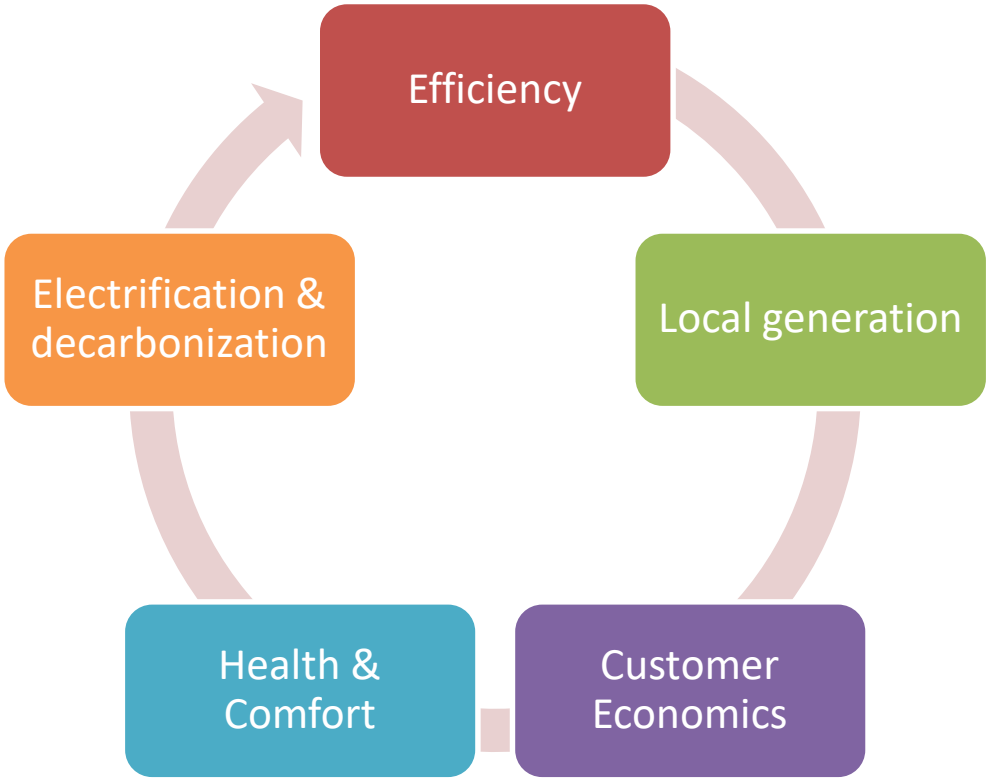
Enabling affordable, healthy, decarbonized communities

Ongoing EPIC collaboration

Ram Narayanamurthy
Program Manager

EPIC symposium
Sacramento, CA
2-19-2019

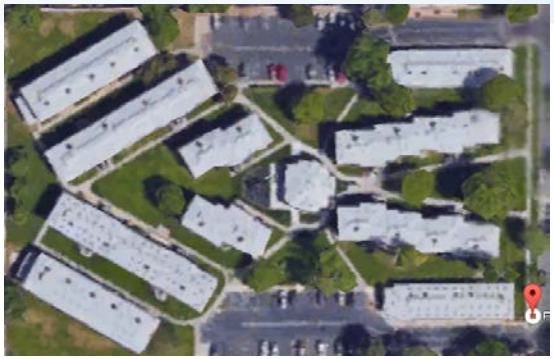
Enabling Healthy, Affordable communities



Health, Comfort and cost all impact "quality of life" in affordable housing communities

Decarbonization through comprehensive efficiency, electrification and community solar could significantly improve quality of life in affordable housing

Ongoing initiatives in affordable housing



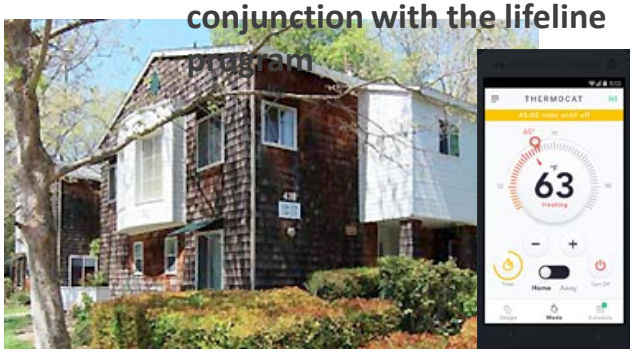
Zero Carbon mixed use affordable housing in Fresno

Comprehensive whole building retrofits with efficiency and electrification to create low carbon affordable housing communities

Job training offered as part of PV installation

Resilient communities with Solar + Storage+ DC power in transitional housing

Addressing the “digital divide” in conjunction with the lifeline program



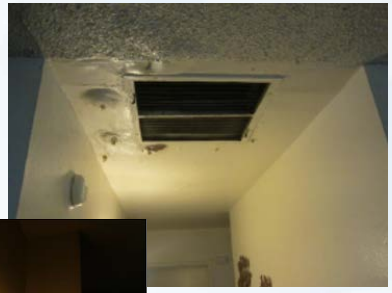
Enhancing Existing Communities

Existing Community

Inefficient gas wall heating

Old Evaporative Cooler Ducting

Outdoor water heater



Inefficient lighting

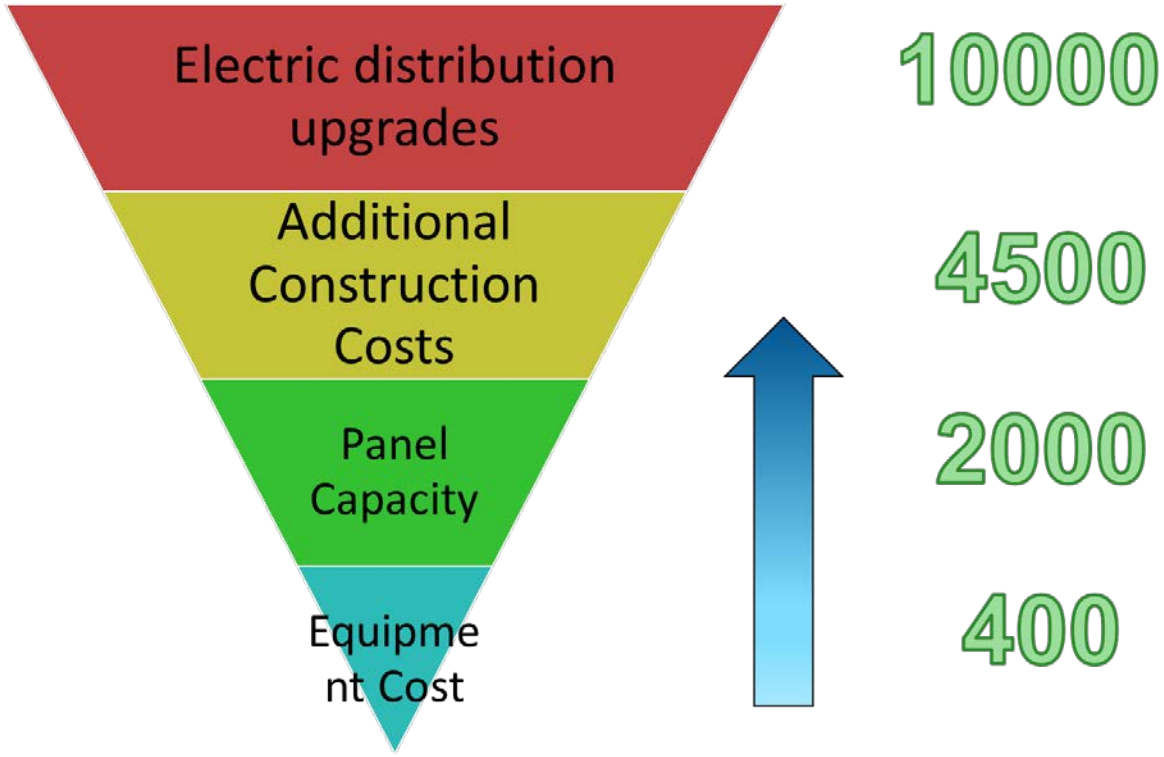
Updated Systems

Heat Pump Replacements

Community PV

Electrification learnings in existing communities

- Affordable housing solar programs such as SOMAH increase customer benefits with electrification
- Customer costs for infrastructure upgrades can be a barrier to electrification



Enabling property owners for community upgrades

Financing Options

- Step 1: Utility Direct Install Programs
- Step 2: Multifamily Affordable Solar Upgrade Programs
- Step 3: Low Income Weatherization Programs
- Step 4: Multifamily Upgrade Programs

OBF, PPA, loans, etc.

Together…Shaping the Future of Electricity